Time-Dependent Transportation Network Design Considering Land-Use and Equity Issue Between Land Owners With Ant Colony Optimization Method

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Abstract

Transportation network design is traditionally known as the problem of selecting the optimal capacity of links in a transportation network.
So far most transportation network design studies focus on the problem of optimizing the network for a certain time in future without considering time dimension, whereas huge economic growth and activities in transportation extent worldwide and rise in value of time infer to consider time dimension in studies.
Time-dependant transportation network design is could be defined as the gradual improvements to the network by considering the changing travel demand over a planning horizon. Even though network improvements could be beneficial for every network user, but it resultant change in land-use patterns and as a result change in land value may not be fare and even could be impairing for some land owners.
In this paper gradual network improvement and change in land-uses are considered simultaneously, and tried to optimize this problem in order to gain an acceptable level of inter land owners equity during the planning period with ACO method.
Keywords: Transportation network design, Time dependant, Land value, Equity, Ant colony optimization.

1. INTRODUCTION

The tremendous growth in traffic demand, which has been started since the 1920s, has caused major traffic problem and congestions such that all the effort of traffic engineers in terms of road construction couldn't cope with this ever increasing travel demand. This inability, together with the limited availability of rescuers; specially budget, has led to the important of optimal decision on capacity improvement and enhancement projects, especially in developing countries.

Due to this need the Network Design Problem (NDP), which is the problem of selecting the optimal capacities in transportation network, has gained attention science mid 70s. NDP has could be classified into three broad categories; Continuous Network Design Problem (CNDP), Discrete Network Design Problem and Mix Network Design Problem. In the CNDP the decision variables, link capacities, are considered to be continuous variables. In the DNDP the decision is on whether or not to implement a predetermined capacity enhancement project. MNDP is a NDP that contains both discrete and continuous variables. Theoretically the DNDP could be considered as a special case of CNDP. Although more realistic, DNDP has been less considered in previous studies. Boyce and Janson (1980) [1] noted that the result obtained by the solution of CNDP or somehow unrealistic. LeBlanc and Abdullah (1979) [2] have also reported more flexibility in the solution of DNDP. However the DNDP spheres for the problem of very high run times that has made it impractical for large scale applications [2].

NDP has been traditionally formulated as a bi-level optimization problem. The upper level problem, that is usually called the design problem or the leader problem, deals with the designer's objective which is usually to minimize some performance measure of the network such as total travel time. The lower level problem, the follower or the user problem, models the reaction of users to the changes imposed to the network by the designer. This problem is usually considered as a User Equilibrium (UE) Traffic assignment problem. This structure of the NDP makes the resultant problem non-convex and non-smooth which adds to the intractability of its solution.