System optimal routing of traffic flows with user constraints using linear programming

Enrico Angelelli[1], Valentina Morandi*[1], Martin Savelsbergh[2], and M. Grazia Speranza[1]

[1]University of Brescia – Italy
[2]Georgia Institute of Technology – United States

Abstract

Solving the road congestion problem is one of the major issues in modern cities since it causes time wasting, pollution, higher industrial costs and huge road maintenance costs. Among possible congestion avoidance methods, traffic assignment is a valuable choice since it does not involve huge investments to expand the road network. Traffic assignment models are traditionally devoted to two main perspectives on which the well-known Wardropian principles are inspired : the user equilibrium (user's perspective) and the system optimum (system perspective). For traffic assignment problems, it is well-known that (1) the total travel time in a user-equilibrium solution can be substantially higher than the total travel time in a system-optimum solution, and (2) the user-experienced travel time in a system-optimum solution can be substantially higher that the user-experienced travel time in a user-equilibrium solution. By seeking system optimal traffic flows subject to user constraints, a comprise solution can be obtained that balances system and user objectives. A linear programming based approach is presented to efficiently obtain a solution that effectively balances system and user objectives. Computational studies reveal that solutions with near-optimal total travel times can be found in which most users experience travel times that are better than user-equilibrium travel times and few users experience travel times that are slightly worse than user-equilibrium travel times.

*Speaker