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Reformulating the traffic equilibrium problem via a smooth gap function. (English)

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Summary: This paper proposes an alternate formulation of the traffic assignment problem using route flows and the shortest Origin-Destination (OD) travel times as the decision variables. This is accomplished through defining a gap function to convert the Nonlinear Complementarity Problem (NCP) formulation to an equivalent Mathematical Program (MP). This formulation has two advantages:

it can model assignment problems with general route costs which cannot be accomplished with existing formulations that use link-flow variables, the objective function is smooth, convex, and bounded, which permits efficient MP algorithms for its solution.

Two solution approaches are developed to solve the proposed formulation. The first is based on a set of working routes, which are modeled as "known a priori" based on travelers' preferences or interviews. The second approach uses a column generation procedure to generate a new route in each iteration on a need basis. For each approach, we use a Successive Quadratic Programming (SQP) algorithm to solve for the solutions.

To show that the formulation is correct, we solve a small example with a general route cost and compare it to the classic traffic equilibrium problem which assumes an additive route cost function.

Finally, numerical results for a medium-sized network are provided to demonstrate the feasibility of the solution approach.

MSC:

90B06 Transportation, logistics and supply chain management
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