TRAFFIC ASSIGNMENT ALGORITHMS: A SCILAB TOOL-BOX, NUMERICAL COMPARISONS

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Our objective is to analyze and compare the performance of the existing algorithms for the traffic assignment problem. We are concerned with the computation time and memory needed of these algorithms. In practice huge networks limit the memory available, and solving bi-level problems, like optimal pricing, requires using traffic assignment algorithms many times. A trade-off must be done between those issues so a comparative study of these algorithms is worth to be done.

We have developed a tool-box in Scilab with the implementation of such algorithms. This tool-box is freely distributed as well as Scilab. Scilab is a software with a Matlab-like syntax, that allows the addition of tool-boxes developed for specific problems. More specifically we have:

- A Scilab data-structure called netlist that consists of a graph for the geographical data, the parameters for the link performance functions and the transport demands. It plays the role of a rudimentary geographical database.
- A graphical interface that allows the input and edition of data along with the visualization of the results.
- A library of algorithms to compute the traffic assignment.

1. SINGLE-MODE CASE

We consider the determination of the user equilibrium in the deterministic case of one mode of transport. We assume that the travel time over each arc depend only on the flow of that arc and the travel times over routes is the sum of the travel time over the arcs. Among the implemented algorithms we have:

- All or nothing (AON)
- Probit and Logit assignment
- Frank-Wolfe (FW)
- Disaggregated simplicial decomposition (DSD)

The idea behind the DSD algorithm (see [2]), is to minimize the Beckmann potential functional over the space of route flows, instead of the space of arc flows. Since the number of routes is exponential in the size of the network, this algorithm uses a column generation approach. The new columns generated by the algorithm are the shortest path routes for each commodity. In a simplicial space corresponding to a restricted number of routes, the
optimum is sought by a restricted quasi-Newton method which has as subproblem a quadratic knapsack problem (QKP) that is solved explicitly. We characterize analytically the solution of the QKP problem as the zero of a strictly decreasing convex function. Then we propose a Newton-like method to find it. This method converges in a finite number of steps bounded by the number of routes for the given OD. It is easy to see that this procedure can be done for all the commodities at the same time, i.e. working vectorially in contrast with the Brucker’s algorithm (see [1] and [6]) that does not allow this vectorization, at least in a direct way. We will also mention some numerical experiments that can be seen in [4].

2. Multi-mode case

In the general case of many traffic classes, the equilibrium condition is no more equivalent to the optimality conditions of a minimization problem. Different algorithms have to be designed in consequence. In this case we will present a relaxation algorithm, that solves the problem through a sequence of single-class problems.

A demonstration of the state of the toolbox will be presented together with a numerical and comparative study of different algorithms.