The Urban Transit Network Design Problem

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Abstract

In this work we consider the problem of simultaneously designing the infrastructure of a urban bus transportation network and its set of lines while minimizing the total travel time of all passenger willing to travel in the network. As main differences with respect to other works in the bus transportation design field, we do not consider an a priori line pool, but we design the set of lines from square one, presenting a detailed description of the travel time (which incorporates the time spent in transferring along the passengers paths) and we jointly determine the transit assignment accordingly to the users' minimum trip time. Most authors incorporate transfers into the computation of the travel time as a penalty term considering only the number of transfers. In this work we are interested in introducing a detailed description of the transfer time. To this end, we consider two layers: the first one affecting the off-board passengers movement (pedestrian layer) and the second one corresponding to the road infrastructure over which buses can run along (road-infrastructure layer). In a realistic way, we can distinguish two types of transfers: transfers at the same stop and transfer between different stops. Obviously, the second type requires an extra-time to walk between stops over the pedestrian layer and therefore, a greater discomfort for passengers.We present a mathematical programming model for solving the problem on the directed graph that results when superimposing both layers. We illustrate the problem with some computational experiments over several networks.

Keywords: bus, network design, line planning, mathematical model

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