Combining two zoning systems in equilibrium network models

by

Lídia Montero, Esteve Codina
Statistics and Operacional Research Department
Universitat Politècnica de Catalunya

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Transportation planning network equilibrium models require detailed information from origin zone to destination zone trip flows. Origin destination trip data volumes usually are roughly estimated from mobility surveys, and it is known that the estimation errors for moderate to small origin destination trip volumes are too high for acceptable sampling sizes, taking into account constraints in the budget for a transportation study. In fact only major origin destination volumes can be estimated with a medium error level. Additionally, some applications require major changes in the zoning system because the source of data acquisition differs substantially from the currently zoning system adopted by transport authorities.

An example of this is the use of data collection techniques by means of electronic technologies such as mobile tracking or bluetooth scanning for which a natural zoning system is more related to the location of receptors rather than a zoning system oriented to a statistical surveying of the population. Another example is the use of local origin destination surveys at selected points in the network at large urban areas for which models contain a vast number of zones, being sometimes difficult to locate either origin or destination in the answers of respondents. In these situations this brings the problem of rendering useless trip tables estimated at previous studies or for distinct purposes and/or the rebuilding and calibration of large transportation network models in order to make them fit the new required zoning system.

This paper considers and analyzes some transportation network equilibrium models capable of combining two distinct zoning systems so that estimated volumes coming from distinct sources of data collection can be made compatible at distinct steps of the modelling process in a transportation planning study.

After the introduction and motivations of the paper, an initial model based on the entropy maximizing principle is presented. The structure of the problems is that of a convex multicommodity network very similar to the classical multiproportional schemes used in trip distribution modelling. It is shown how this basic model can be solved by means of the partial linearization algorithm of Patriksson (4) and numerical examples will be presented for an application involving two zoning systems for a regional area. Zones of one zoning system are smaller but not entirely included in the zones of the other system. Available data for the application consisted of one mobility survey carried out on one of the zoning systems and partial information about mobility for the smaller one. A sensitivity analysis of the relevant parameters of the model is performed in order to show the validity of the approach.

As an extension of the basic model there follows the development of a general asymmetric traffic equilibrium model for two zoning systems for which the corresponding variational inequality is formulated and analyzed. For the case of diagonal jacobian in the link travel time functions the model for the two zoning systems framework presents several analogies to the Evans's classical combined trip distribution and assignment model (3). Using the marginal function for the fixed demand traffic assignment problem the diagonal model is rewritten and it is shown how can be solved also by means of the partial linearization scheme of Patriksson (4)

The formulation presented for equilibrium models with two zoning systems is general enough so as to permit the consideration of complex equilibrium models for fully congested transit networks such as the one of Cepeda, Cominetti and Florian (1), because, as shown in Codina (2) it can be rewritten as a variational inequality problem. The application of the two zoning system framework developed in the initial section in the case of user equilibrium for congested transit networks is also analyzed and presented.

References

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