

CYCLISTS' SPEEDS IN HIGHWAY MODELS

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ENGLISH

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When large road schemes are designed in the UK, computer models of traffic are built to determine the effects of the changes. They do not normally consider cyclists. As a result, cycling is often forgotten when large scale transport planning is undertaken. Some attempts have been made to include cyclists in traffic models but a better understanding of the factors affecting cyclists' route choice and speed is needed. Speed is used as a proxy for other factors when determining route choice. This paper describes work done with a TRIPS model of Leicester to derive factors which can be used to modify cyclists' modelled speed, in an attempt to replicate their choice of route. Considerations include congestion, highway surface, quality of traffic environment and route knowledge.

DEUTSCH

DIE GESCHWINDIGKEIT DER RADFAHRERN IN IV NETZ MODELLE

Wenn große Straßenmassnahmen in U.K. entworfen werden, werden Verkehrsmodelle eingesetzt, um Wirkungen der Änderungen zu studieren, die normalerweise das Radfahren nicht berücksichtigen. Deswegen werden sie oft vergessen im übergeordneten Verkehrsplanung. Man hat einige Versuche gemacht, das Radfahren in den Modellen miteinzuschließen, aber ein besseres Verständnis der Routenwahl der Radfahrer ist notwendig. Wenn man die Routenwahl in einem Modell berechnet, ist die Geschwindigkeit - als Ersatz für andere Faktoren benützt. Dieser Vortrag beschreibt die Arbeit mit einem TRIPS Modell für die Stadt Leicester, wo die Geschwindigkeit der Radfahrer zu studieren war. Einige Parameter für die Korrektur der Fahrradgeschwindigkeit, um eine realistische Routenwahl zu erreichen, wurden erzeugt. Diese Faktoren berücksichtigen Zeitverlust im Stau, Routenkenntnis, Straßenbeleg und Qualität des Verkehrsmilieus.

SLOVENSKO

HITROSTI KOLESARJEV V CESTNIH MODELIH

Ko v Veliki Britaniji delajo osnutke za velike cestne projekte naredijo računalniške modele prometa, da ugotovijo učinke sprememb. Kolesarjev navadno ne upoštevajo. Kot rezultat tega je kolesarjenje v načrtovanju prometa pogosto pozabljeno. Kolesarje so nekajkrat poskušali vključiti v prometne modele, vendar je potrebno boljše razumevanje faktorjev, ki vplivajo na kolesarjevo izbiro poti in hitrosti. Hitrost, pri odločanju za pot, uporabljajo kot nadomestilo za ostale faktorje. Prispevek opisuje delo z modelom TRIPS, za mesto Leicester, kjer so proučevali hitrost kolesarjev. Dobili so nekatere parametre, ki jih lahko uporabljajo za korekturo hitrosti kolesarjev z namenom, da reproducirajo njihovo izbiro poti. Ti faktorji upoštevajo izgubo časa v prometnem zastoju, poznavanje poti, kakovost cestne površine in kvaliteto prometne okolice.

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INTRODUCTION TO MODELLING

What is modelling? It is a process which attempts to represent the effects of behaviour and events in such a way that it is possible to make predictions about events in the future. In the case of highway modelling, this is done by reducing interactions to mathematical processes.

The activities that have been reduced to numbers can then be manipulated by mathematical functions. For traffic, the area in which we are interested, 'assignment' highway modelling takes the approach that every journey has a cost associated with it. This may be expressed in monetary units (e.g. the price of car parking), but is normally expressed in terms of time or distance associated with a journey (for example, if journey B is longer than journey A then journey B

is considered to have the greater cost). Individual elements of journey costs are added together to produce a final cost. For example, the time lost because of the effect of congestion may be added to the time the journey would take if there was nothing to slow it down (free-flow speed) to arrive at a congested journey time.

Other measures are possible: one sometimes used is 'attractiveness', which may be defined in terms of surroundings (subjective) or, for example, hilliness (objective).

For the purposes of modelling, the motorists' objective is assumed to be to minimize costs (e.g. a weighted combination of time and distance). The evidence is that cyclists have similar objectives (see Sharples, 1999 and Hopkinson et al, 1989). However, cyclists sometimes have a greater choice of route, since there are routes open to them which are not available to motorists. This includes cyclepaths and paths shared with pedestrians. These may be adjacent to the carriageway or through, for example, parks or other designated recreational routes. Cyclists can also make use of areas which are banned to cycling, such as pedestrianized areas, by dismounting and pushing their cycles. Cyclists sometimes cycle in these areas illegally, although in the absence of any surveys of the frequency of this behaviour, it is not possible to tell whether this happens often enough to distort the results of the model.

Another factor is the legal system of the location in question. In England, cyclists have a right to use any highway from which they are not specifically banned (an example of the latter is motorways). They don't have to use a cycle track just because it has been provided. However, in some countries, such as Germany and the Netherlands, cyclists are required to use a cycleway rather than the adjacent carriageway if the former exists. This will restrict the choice of (legal) routes through a network for cyclists.

The relationship connecting time and distance is speed, so speed and anything for which speed can be a proxy, can be used to evaluate journey costs.

Because modelling is normally used to make predictions, it is usual to create more than one model. The first model represents the base year, against which changes will be compared (and which should be calibrated to ensure that it is a realistic representation of that year). The other, future, model represents a year in the future - perhaps five, fifteen or 25 years after the base year. It incorporates changes, the effects of which are to be tested, such as new roads and a change in population. It is used to gain some idea of the effects these changes will have.

The highway model for cycling route choice purposes consists of a highway network, represented in the computer by links (stretches of road, path, etc) joined at nodes (i.e. junctions or changes in the nature of a link). Not all roads and paths (and therefore junctions) are represented in the network; only those which are relevant. Nor is it necessary, even when building the network representation with a graphical tool, to include every bend in the road - only the start and finish point of the link are important. To add such unnecessary detail to a model increases the time required to create the network and the computer time required to run it.

Associated with an (essentially) static highway network are the tables (matrices) of origins and destinations which represent the journeys of the users of the network.

When a network has been built and a matrix of journeys constructed, it is necessary to assign the journeys to the network to determine which routes are taken through it. There are several algorithms used for this; the most relevant to (U.K.) cycling are the so-called stochastic methods, which reflect the variability of the reasons people use to choose a route: for example, limited knowledge of the routes available and uncertainty about the actual 'cost' of using a specific route.

Once the assignment has been done and the trips loaded onto the network, further analysis of the model can be undertaken: for example, the effects of adding more cycle routes, or an examination of the network to find gaps in the cycle network.

This article discusses work done to model cycling in Leicester, England using the TRIPS highway modelling package. TRIPS is a general purpose model and therefore contains no built-in assumptions about how the amount of cycling relates to the land use, population or employment patterns of the study area.

LEICESTER

Leicester is a medium sized city (population 400,000) in the midlands of England with pro-cycling policies.

Cycling initiatives include a network of cycle routes around and through the city; and a cycle centre, known as the Leicester Bike Park, which provides supervised cycle parking. Cyclepaths are also provided on much of the outer ring road although the provision for negotiating the roundabouts is limited.

These cycle routes use a combination of quiet roads, converted disused railway, shared footways, park paths and cyclepaths beside roads. Special crossings and bridges have been installed in places to help cyclists cross roads; there are also shared subways, a contraflow cycle lane and cyclist exemptions to road

closures.

LEICESTER CYCLE MODEL

The construction of the Leicester Cycle Model was undertaken by MVA as part of the Central Leicestershire Strategic Transport Studies (CALTRANS). The object was to create a model suitable to carry out an outline appraisal of the cycle schemes proposed for Greater Leicester; suitable for use by the client's cycle development staff; and to provide data inputs to the strategic model used in the CALTRANS study).

The cycle model was based on the existing Greater Leicester Traffic Model. This covers an area with a radius of about 10 miles (16 km) from the centre of Leicester. The existing model was modified to make it more appropriate for cycling (e.g. new links, in particular those representing the city's cycleways and other cycle facilities, were added).

Two networks were created: one for the base year (1995) and one for the forecast year (2011). The base model contained all the cycling facilities which existed in 1995; the forecast year all the cycle facilities whose route or location had been finalized.

Matrices of cycle trips were synthesized, based mainly on the matrices of car and public transport trips which had been created for the Greater Leicester Traffic Model using assumptions about the amount of cycling in Leicester and relative trip length distribution. These were then adjusted to fit the available observations of the amount of cycling in Leicester, using journey to work estimates from the 1991 census and cycle counts which had been done by Leicester City Council.

The matrices for the forecast model were factored from the Greater Leicester Transportation Model on the assumption that cycling would represent about 12% of trips, including walk trips.

Speeds

This paper was prompted by a paper from the Velocity conference in Barcelona in 1997 (Barber, 1997), which discussed the use of GIS to model cycling. It asked what speeds should be used when attempting to model cycling. Therefore this paper concentrates on the choice of speeds and modifications to the chosen speeds although there are many other considerations when modelling cycling.

Cycling is a physical activity; cyclists' speed depends on their own strength and will therefore vary between individuals. This is in contrast to driving, where minimal strength is needed to alter the vehicle speed. Hence, there is greater variability in cycling speeds than for urban motorized traffic.

All modelling is an approximation to reality, and the output is no better than the input into the software. The saying 'garbage in, garbage out' is as true in modelling as in any other computing process. Therefore it is important that the information supplied to a model is as accurate as possible.

For this reason, the speeds used should reflect the actual conditions on the ground, rather than any desired outcome. For example, a cycle facility should not be assigned a speed higher than is likely to be attainable on the ground. To do so would cause cyclists to appear to travel faster and therefore their journey time, and associated costs, to be lower, than in reality. The model would assign more cyclists to that route, which would give a false impression of the viability of the route. It cannot be assumed that all cyclists will use a cycle facility just because it exists; the evidence is that cyclists value direct and/or fast routes more highly than those which are circuitous, even though the latter may appear to be safer (see Sharples, 1999 and Hopkinson et al, 1989).

In the Leicester model, therefore, speeds were assigned to cycle routes, depending on how fast cyclists were expected to be able to travel on the type of highway in question.

On links where cycling was not allowed, but which were thought to be likely to be part of a cycle route (perhaps as a short cut) a speed of 5 kph (walking speed) was assigned.

Paths shared with pedestrians, aimed at either the utility or the recreational cyclist, were assigned a speed of 10 kph, because it was felt that the presence of other, slower users means that cyclists would not be able to sustain the higher speeds they could achieve on the roads, as they would have to give way to pedestrians.

Furthermore, these paths are favoured by less confident cyclists and young children, who are likely to be cycling slowly. These paths are rarely more than two or three metres wide and therefore the presence of slower cyclists will invariably slow down cyclists who wish to ride fast.

In addition, the surface of some of these paths (where, for example they have been constructed of stone dust) will discourage fast riding. In particular, these paths will cause problems in wet weather, when puddling may occur.

Cyclepaths were assigned a speed of 15 kph: their surfaces are generally such as to permit higher speeds than the shared paths. Although pedestrians will wander onto these paths, a well designed cyclepath will have been laid out so as to avoid any obvious pedestrian desire line.

Links in cycle routes on the road were assigned a speed of 20 kph. Many cyclists will say that they can achieve a faster journey speed than this. However, in the absence of substantial surveys of cyclists' speeds on the road in the U.K., it was felt to be a reasonable average speed for utility cyclists on a level road.

In the Leicester model, roads are assumed to be free of any slower moving traffic (e.g. pedestrians, animal or farm traffic) which might cause serious delays to other traffic. Clearly this may not be true in all situations (for example, third world roads, with vehicles drawn by animals).

Adjustments to speeds

If a route was particularly hilly (i.e. if a link crossed two contours on the 1:25,000 map (i.e. a difference in height of 10m) then the speed assigned to that link was decreased by 5 kph)) That is, a speed of 15 kph was used as a proxy for the difficulty of getting up a hill on the road (such considerations do not usually apply to other types of links).

Provisional work on other speed adjustments, to simulate the effect of congestion, and of traffic on cyclists' perceptions of safety and intimidation, were also explored in this work. However, no firm conclusions were reached.

CONCLUSION

Modelling uses speed to calculate the likelihood that a motorist will take a particular route through a highway network. The evidence is that cyclists are also mainly concerned with the speed and length of their journey when choosing a route. Therefore it is considered that the modelling tools available to model motor traffic are valid for modelling cycling. However, to model cycling it is necessary to go into greater detail than in a motor model. Some of the reasons: in particular the variability of cyclists' speed, have been outlined here.

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