Using smartphones for cycle planning

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Abstract

There has been an inherent lack of information available to transport and urban planners when looking at cycle networks in our towns and cities. A mobile app is set to turn cycle planning on its head.

Imagine the power of having access to GPS records of thousands cycle trips in and around your city. Data showing cycle route choice, travel patterns, delay points, speed and travel time covering much of the New Zealand network.

Strava is a GPS application which logs individual's cycle trips. It was created in 2009 and has experienced rapid growth with some 77 million cycle trips logged to date. Until recently, the use of Strava data for planning purposes has been minimal. In May 2014 the Oregon Department of Transportation bought a data set from the developers in a revolutionary move to help make decisions about their policies, plans, and projects in the area. In June 2014, Auckland Transport purchased a year's worth of data for the Auckland region.

This presentation will look at a real world example of how this data can be a powerful tool for cycle planning and how you can use it to inform cycle planning and infrastructure in your area.

Introduction to the data

Cycle planning has typically suffered from a lack of available data. This paper explores an emerging database which provides network wide cycle trip data.

Strava is an extremely popular running and biking app on smartphones and GPS devices, and has long been at or near the top of the fitness app charts. The company has pooled annual datasets showing users running and cycling habits, which it recently published as a global heat map popular exercise routes around the world. The company has recently begun to release aggregated data to the transport industry under a sub business named "Strava Metro".

Strava Metro offers a data service which aggregates a years' worth of cycle data for a geographic area (in this case for Auckland) which allows the assessment of historic cycle patterns and trends over the 1 year period. The data can be used to find cycle speed, delay, volumes, time of travel and route choice on a regional and national level.

Auckland Transport purchased a years' worth of data in Auckland, New Zealand between May 1, 2013 and May 31, 2014 for use on a Corridor Management Plan. For the years' worth of data within the Auckland region, 4,809 distinct cyclists were recorded making a total of 179,018 trips.

How well does Strava data represent the cyclists in the Auckland community?

The Strava community is made up of all types of cyclists and surveys have shown that most Strava cyclists do not refer to themselves as competitive. Globally, more than half of all rides recorded on Strava in denser metro areas are commutes. Strava Metro provides the single largest database of cycle to work trip currently available to the transport industry.

Anecdotally, in metro areas, nearly everyone is a commuter – either commuting to work, or commuting to the ride they'll be doing outside the city. Strava Metro data enables users to analyse patterns by time of day, day of week, season and local geography. It's simple to filter the data to show only commuter data as well.

Commuter's vs Recreational Cyclists

Commuter data is derived by 3 methods. The first is the commute flag that is native to the Strava experience. When logging any activity users are faced with an option to tag any cycle activity with the trip purpose "Commute". The second is an automated process that locates origin and destination of cycling trips that are within duration and distance constraints. The third is fuzzy name matching from the user entered activity titles. Overall 124,673 activities were recorded, of which 32,220 have been classified as commute trips which corresponds to around 25% commute data.

Within the Auckland region around 75% of data relates to recreational use, with 25% relating to travel to work trips. The *median trip distance time is weighted towards recreational trips with a median trip distance of 30km (90 minutes).*

Strava Demographics

A total of 4,721 unique athletes have recorded rides within the region (Strava 2014). The data provide some basic demographics on users which is useful in understanding who uses the application. Age and sex of users is provided in Table 1. The age of cycle users indicates poor representation of "under 25" users. This could be related to lack of access to GPS devices. Female users represent a smaller percentage of the total Strava users.

Age of cyclist	Male	Female
Under 25	240	46
25-34	570	127
35 - 44	981	134
45 - 54	833	120
55 - 64	328	42
65 - 74	79	5
75 - 84	2	0
85 - 94	0	0
No age recorded	717	185

Table 1: Strava Population Demographics (Strava 2014)

Strava Data vs Actual Cycle Surveys

An actual cycle survey was undertaken on Thursday June 5th 2014. Cycle counts recorded as part of this work have been compared to Strava data from the month of June to gain an understanding as to the proportion of trips which are recorded by the data set (Figure 1).
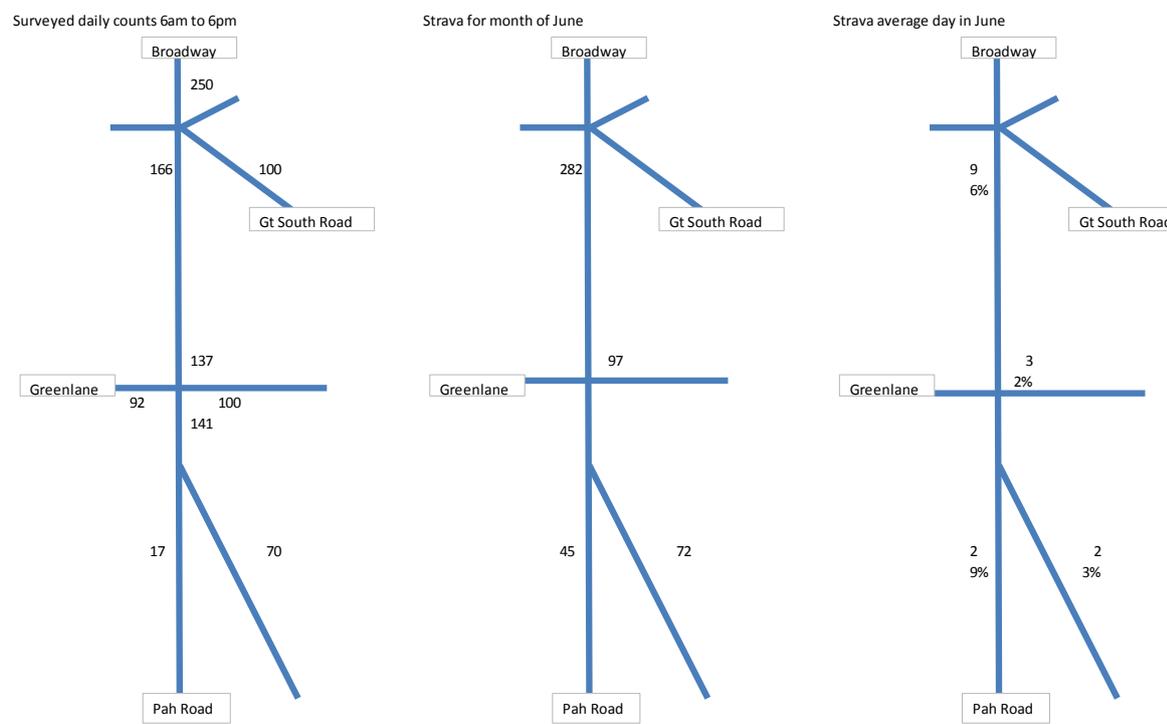
Figure 1: Surveyed Cycle Trips vs Recorded Strava Data: Manukau Road Corridor

On the Manukau Road corridor, Strava data captures between 2% and 9% of cycle trips throughout a day.

While capturing a relatively low proportion of trips during any given day, the dataset picks data from a long period of time giving a comprehensive dataset of route choice and travel patterns. When Strava data is used along with counts at selected locations, it combines to provide a rich picture of cycle travel patterns, specifically cycle flows across the city could be mapped.

What data is available?

Data is classified by direction, time periods (AM, IP and PM) and whether the trip is related to a commute or not. Further classification is available to distinguish between seasons. The summer season was chosen for Auckland.

The following fields are available:

- Count of unique cyclists
- Count of trips (regardless of unique cyclists)
- Median time over a section of road

An example of the data set can be seen by Figure 2 which provides a heat map of commuting cycling counts over the Auckland network. This data is based on volumes for the years' worth of data from May 2013 –May 2014.
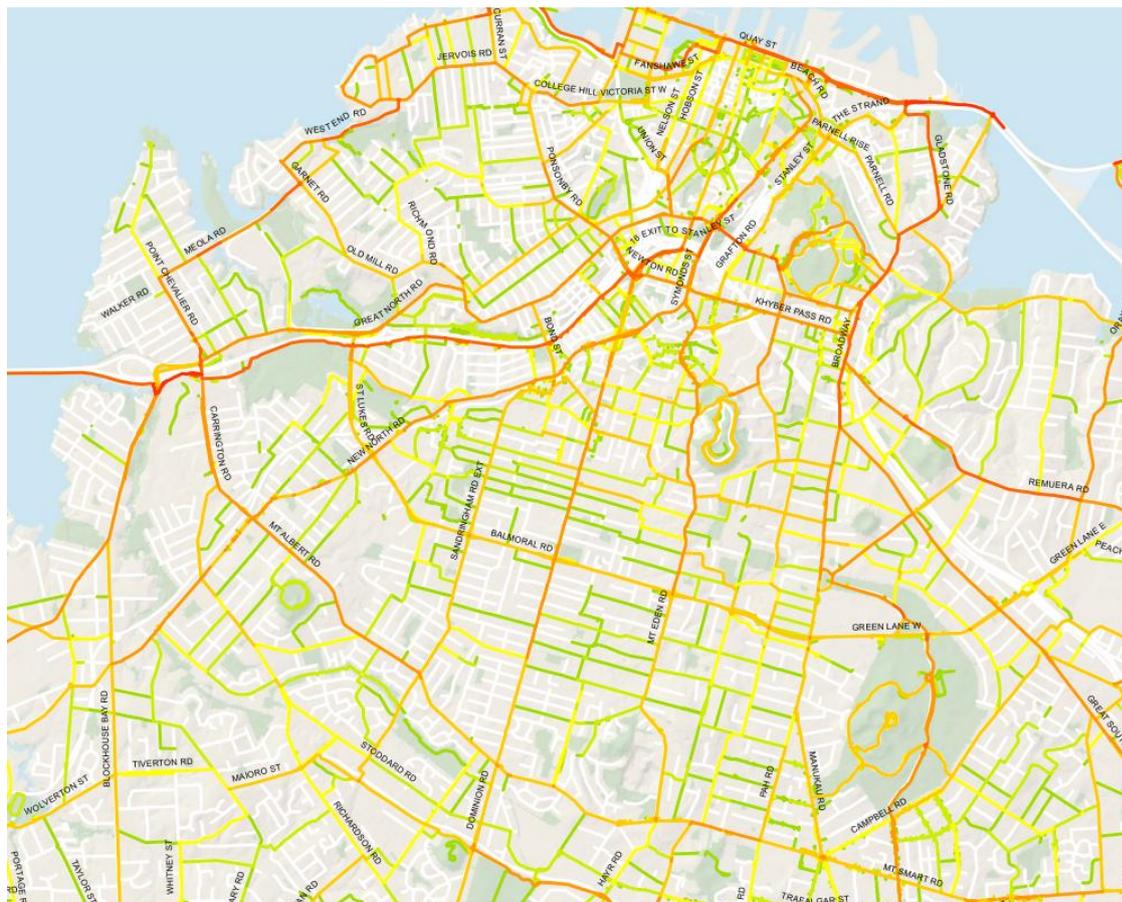
Figure 2: Commute cyclist count (2013/2014 year)

Issues and Nuances

A couple of nuances have been picked up when analysing the Strava dataset;

<u>Data recorded from a vehicle</u>**:** People forgetting to switch off the tracking function when getting into a vehicle. This is evident through the presence of data on the motorway network. Limited other examples can be found within the data and these can be removed based on speed. Strava has a self-moderating function which allows users to filter each other's data when a motor vehicle is involved so the data is clean for the majority of circumstances.

<u>Cycling group rides</u>**:** Cycling groups (or bunch rides) often contain several cyclists recording their ride with Strava. This leads to Strava data with higher trip density on these routes. Strava data on popular Auckland bunch ride routes is noticeable higher density than surrounding routes. While this arguable still provides an accurate representation of cycle demand on the network, if the commute classification is chosen, the effect of bunch rides on the network reduces.

Applications - Manukau Road CMP

Strava data was used in the Manukau Road Corridor Management Plan as a tool to understand current cycling patterns in the corridor and on neighbouring routes. While Strava data is inherently biased towards recreational users, commuting data was available and trends in route choice were mirrored between datasets.

Strava data helped the project team in a number of ways during the CMP process which are discussed in the following sections.

Providing a wider network view

Strava data allowed the team to look at existing cycle patterns for not only on the corridor, but surrounding cycle network. The data allowed a comparison of the Manukau Road corridor to neighbouring corridors such as Mt Eden Road and Gillies Avenue. The environment on Manukau Road is inhospitable to cyclists with high traffic volumes and narrow lanes but the data indicates the route was still widely used. When existing use patterns were compared with grade on the roads, the reason became evident. Manukau Road is flat.

The team then looked at grade and cycle trips for parallel cycle routes to the Manukau Road corridor (Figure 3). The correlation of Strava data and grade of the roads allowed the team to quickly discount alternative route options. Low volumes of existing cyclists used the routes with steeper grades indicating these routes were not attractive and unlikely to be used should facilities be provided along them.
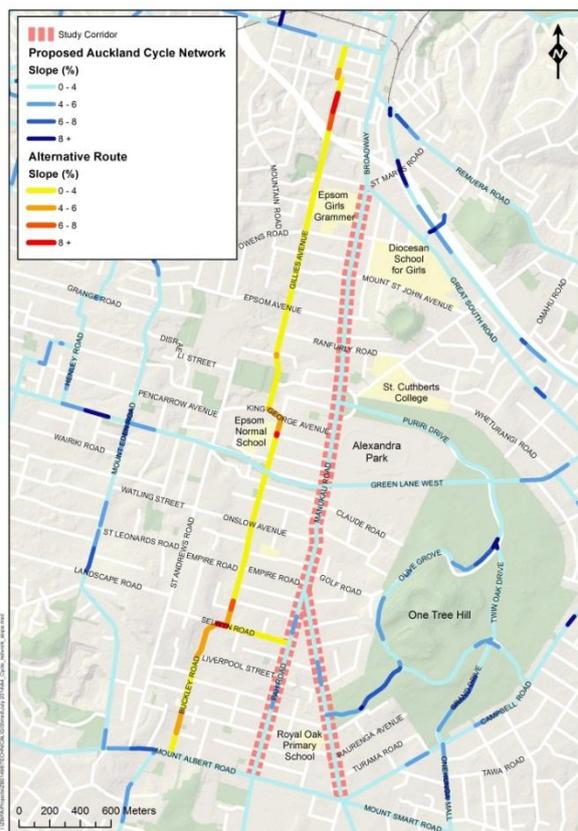
Figure 3: Grade assessment of Alternative routes

Focus on connections

Cycle networks are often developed in an incremental manner, as such one section is rarely connected to the next section. This is a reoccurring problem symptomatic of looking at finite corridors rather than the network as a whole. The existing cycle pattern data allowed the team to develop understanding of where people are joining the Manukau Road corridor and leaving it. The assessment found that a popular north-south route through the One Tree Hill Domain and Cornwall Park was joining onto Manukau Road in the northern section to connect into Newmarket.

In the south of the corridor, we found that the majority of cyclists did not continue south to Queenstown Road or Manukau Road rather connecting to Mt Albert Road (an east west arterial). Queenstown Road was identified in the Auckland Cycle Network as a cycle connector providing a strategic connection to the SH20 cycleway. In reality, very few cyclists used it due to steep grades and a motorway interchange to contend with. In this instance cyclists seem to favour the gentler gradient of connections a kilometre either side.

This data allowed the team to prioritise facilities on the southern part of Manukau Road rather than including Pah Road. This data allowed us to prioritise facilities on the southern part of Manukau Road rather than including Pah Road.

Identifying gaps in the network

Cycle Metropolitan routes (cycle metros) are the highest level of cycle provision and represent high quality routes which will cater for both experienced cyclists and attract new cyclists. At present cycle metros within the Auckland Isthmus form an incomplete ring route around the central isthmus. Existing cycle metro routes can be observed to attract the highest cycle volumes within the current network. Tamaki Drive and the North Western Cycleway are the most utilised routes in both commuting and overall cycle trips as indicated by Strava data.

While the Auckland Cycle Network (ACN) identifies a cycle metro along the rail main trunk line, no progress has been made developing options or securing funding for this facility. This facility is unlikely to be implemented in the short or medium term. A gap can be seen within the Isthmus (as depicted by the blue dashed arrow in Figure 4), as currently no north-south connections are made across the central isthmus.

Figure 4: Cycle Metros within Auckland

Figure 5: Strava trips through the central isthmus

When considering appropriate locations for a potential north-south facility, existing cycle patterns (both all trips and commute trip data) indicate the most popular route through the Central Isthmus occurs through the One Tree Hill Domain and Cornwall Park (Figure 5). While this is a popular recreational route, commuter data reinforces this as an attractive route with high commuter volumes compared with alternative north-south routes.

When other factors were considered such as grade, traffic conditions, destinations, absence of buses this route appears to be an attractive corridor for a cycle metro. North of Cornwall Park, cyclists can be observed to use one of two route options, both Manukau Road and Market Road/Great South Road are used in the north-south direction. Both these sections experience similar levels of cycle traffic and converge on the Broadway approach to Newmarket. The Market Road/Great South Road route is approximately 40% longer than the Manukau Road option however includes higher quality cycling facilities for cyclists including shared bus lanes on Great South Road and the additional journey time is only approximately 3 minutes.

What else can be done?

Intersection data and midblock analysis

Under the Corridor Management Plan project, Strava data was used at a network and route choice level. The data provides potential for more detailed intersection or road design using median travel time information. Delay and LOS can be calculated for an intersection or midblock section, which could in turn feed detailed data into Network Operating Plans. Cyclist mean speed over a section of road can be determined in each direction.

Delay at intersections for cyclists is not necessarily the same as a car. Strava data provides data to assess delay points in the network for cyclists.

Design of cycle ways / bicycle paths

Observation of existing cycle patterns can provide important lessons for cycle way and cycle path design. It provides a record of trips along a corridor, locations where cyclist access and divert off the corridor and highlights important connections to any facility.

For example: The SH20 cycleway provides a high quality route parallel to the SH20 motorway corridor. Observations of existing Strava data (Figure 6) indicate a section of the cycle path experiencing a reduced demand as a large portion of trips divert to a parallel location road over a 1km length. When looked at in more detail, this particular section has grades of over 8%, so cyclist are diverting along a longer local road route to avoid the steep grade in favour of a less severe hill. This trend is only present in the uphill direction.

Figure 6: Strava Commute trips for SH20 Cycleway

Observations like this provide an important check between cycle path theory and what happens in reality. It can provide information on route choice of cyclists for matters such as the maximum grades cyclists are willing accept, how fast cyclists travel over a section of path, and the location of key connections.

Conclusions and comments

Strava data fills a significant gap in providing data of cyclist behaviour on a network level. Whilst the value of the data is only just beginning to become apparent, the team have made the following conclusions from working with the dataset:

- It captures a relatively small proportion of total cycle trips but the strength comes from the duration that the data covers and as a result allows you base analysis on a far greater number of trips than you would typically have from a cycle count survey.

- Like any big dataset, it has issues some of which have been identified. There is danger in looking at the data in isolation but in combination with other factors such as grade, traffic conditions and destinations it becomes a powerful tool for cycle planning and design.

- The data is assessable and relatively cheap compared with the traditional methods of gathering data.

- The data provides proven benefits when looking at a network level and has the potential to assist in more detailed assessments of individual intersections, cycle paths and sections of road.

Acknowledgements

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References:

Strava, 2014. StravaMetro Product Documentation: Auckland.