When and Where Tourists are Viewing Exhibitions:
Toward Sophistication of GPS-Assisted Tourist Activity
Surveys

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Abstract
In recent years, many tourist activity surveys using GPS devices have been conducted, but the
survey methodology needs still to be improved. One critical problem is that we can know
where tourists visit and how long they stay there, but not what they actually do there. Thus, we
investigated the relationship between tourists’ activities recoded by a video camera and their
GPS logs. The result shows that the location history of a tourist itself is not sufficient for
estimating how long he/she enjoys each attraction, and his/her walking speed seems critical for
this estimation.

Keywords: GPS, tourist activity survey, zoological park, logistic regression model

1 Introduction
Global Positioning System (GPS) provides accurate, continuous, worldwide, three-
dimensional position and velocity information to users with appropriate receiving
equipment (Kaplan, 1996). GPS expands the possibility of tourist activity surveys,
because with an effective use of GPS devices we can investigate where tourists visit
and how long they stay there, without recording their activities manually. As a matter
of course, there are also some drawbacks; first of all, GPS receivers work properly
only in outdoor environments. Measurement error and battery lifetime are other issues
that need to be considered. In tourist activity surveys, however, there remains one
more critical issue—GPS logs tell where tourists have been to, but not what they have
been doing there. Tourism is an activity that involves a large variety of activities.
Thus, for discussing marketing strategies, renovating tourist spaces, and providing
appropriate information for tourists, it is essential to clarify tourists’ behaviours in
conjunction with their attributes, such as age and gender. For promoting tourist
activity surveys to know tourists’ behaviours, an intelligent technique for inferring
tourist activities from their GPS logs will be highly desirable.

As a first step toward this technique, we investigated the relationship between the
tourists’ activities and their GPS logs, focusing on the simplest activity of tourism—
viewing something. Then, we developed a statistical model with which we can discern
from a GPS log whether a tourist had been viewing exhibitions or not at each
moment. This model can be applied to GPS logs in previous surveys to estimate the
time spent by tourists for viewing each exhibition and eventually, to estimate the
attractiveness of each exhibition.
The remainder of this paper is organized as follows: Section 2 explains the background of this research. Section 3 reports our initial GPS-assisted survey at a zoological park and points out its problems. Section 4 describes our supplementary experiment that aims at developing a new technique for estimating tourists’ viewing time. Finally, section 5 concludes with a discussion of future work.

2 Background

Recently, GPS loggers have become smaller, lighter, and less expensive. In addition, mobile communication devices equipped with a GPS sensor, such as smartphones, have become rapidly widespread all over the world. Along with this trend, activity surveys using GPS devices have been conducted in various fields (Yabe et al., 2010). Especially in tourism studies, location history data recorded by GPS devices are highly useful to clarify what attractions tourists have visited in what order and how long they have stayed there (Kurata et al., 2010).

If tourists’ spatio-temporal behaviours are well-understood, it would be possible to optimize transportation, operations of tourist attractions, and marketing strategies, all in line with their actual needs (Shoval & Issacson, 2007a). Of course, such information can be obtained from a questionnaire or an observation survey, but usually such surveys are costly and difficult to be conducted regularly for monitoring tourists’ behaviours. On the other hand, GPS-assisted surveys impose almost no burden on tourists and are relatively inexpensive if GPS devices are used repeatedly (Kurata et al., 2010).

GPS-assisted activity surveys have been conducted extensively in transportation studies of motor vehicles. One of its reasons is that it is easy to install GPS devices on vehicles (Shoval & Issacson, 2007a). For example, Nagao et al. (2004) analyzed tourists’ movement patterns in a macro scale based on the data of GPS loggers installed on rental vehicles. Some GPS-assisted tourist activity surveys targeted pedestrians to clarify their movement patterns and characteristics (Asakura & Hato, 2004; Asakura & Iryo, 2007; Shoval & Issacson, 2007b), as well as the spatial use of a city by tourists (Shoval, 2008). Some surveys attempt to extract interesting locations for tourists from their GPS logs (Zheng et al., 2011). However, it still remains as a research challenge to develop a technique for inferring tourists’ activities from their GPS logs, while it is important to know what tourists actually do at each place in order to optimize various operations in a tourist area.

3 GPS-Assisted Survey in Tama Zoological Park

As an example of GPS-assisted tourist activity surveys, we report our survey at Tama Zoological Park (Hino, Tokyo) on 3rd (Fri) and 4th (Sat) of September, 2010. There are three advantages in conducting a GPS-assisted survey in a zoological park:

(i) most exhibitions are located outside

(ii) the number of its entrances and exits, where GPS loggers should be distributed and collected, are limited, and