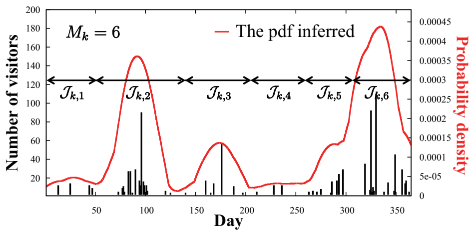
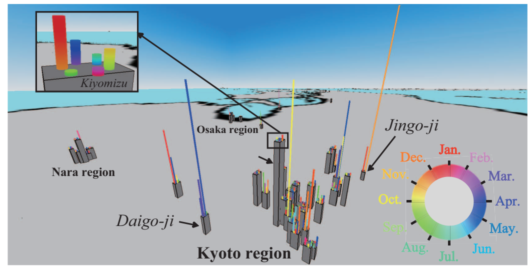
Visualizing Attractive Periods of Popular Photo Spots Using Flickr Data

Satoshi Iwabuchi, Masahito Kumano, Motonori Koseki, Keiko Ono, and Masahiro Kimura
Ryukoku University*



(a) *Result of the season detection for spot "Kiyomizu"*



(b) *Visualization result by the proposed method (Kyoto)*

Figure 1: *Results for Japanese Flickr data.*

1 Introduction

The popularity of cameras with GPS receivers and the emergence of photo-sharing websites such as Flickr have created enormous collections of photos that are annotated with GPS locations, time-stamps, photographers, etc. Thus, one can obtain a large number of observations of where and when people take photos. Since people tend to take photos when they meet visually interesting things on their sightseeing tours, attention has recently been devoted to constructing sightseeing guide systems that exploit the information revealed by the collective behavior of users in photo-sharing websites (see, e.g., [Lu et al. 2010]). Previous work [Crandall et al. 2009] discovered popular photo spots from a large number of geo-tagged photos, and visualized them with the found representative images on maps.

A photo spot represents a spatially localized region, and can have its own proper collection of characteristic periods with respect to the number of visitors (see Figure 1(a)), where we refer to each characteristic period as a *season* of the spot. As a candidate for the attractive period of a spot, we focus on its *burst season* such that it has many visitors within a relatively short period. By effectively visualizing burst seasons, we aim to increase the sophistication of a sightseeing guide system based on collective wisdom. To this end, we deal with a large collection of geo-tagged and time-stamped photos that are taken within a given year, detect the seasons for each of the popular photo spots extracted, and develop a novel visualization system that can effectively analyze and compare the spots in terms of burstiness. In this research, we propose such a visual analysis method that simultaneously visualizes 1) how many seasons each spot has, 2) when each season is, 3) to what extent each season is bursty, 4) how many visitors each spot has in the year, and 5) what spatial relationship the spots have.

2 Approach

Let $\mathcal{D}_0$ be a set of geo-tagged and time-stamped photos that are taken within a specified year. In order to absorb the wide variability in photo-taking behavior across different individuals, we first construct a dataset of photos for our analysis, $\mathcal{D}_1 = \{d_n\}$, by bucketing the geographic locations (lat-long values) and time-stamps of photos in $\mathcal{D}_0$, and sampling a single photo from each bucket for each photographer. Let $\boldsymbol{x}_n$ and t_n denote the geographic location and time-stamp of photo d_n, respectively. Next, we extract a set of popular photo spots $\{\mathcal{R}_1, \ldots, \mathcal{R}_K\}$ by applying mean shift clustering to the set $\{\boldsymbol{x}_n\}$ according to [Crandall et al. 2009], where each $\mathcal{R}_k$ is the minimal rectangular region including some cluster obtained from $\{\boldsymbol{x}_n\}$. Moreover, in order to detect the seasons for each spot $\mathcal{R}_k$, we partition the whole period (the year) $\mathcal{J}$ into M_k subperiods $\mathcal{J}_{k,1}, \ldots, \mathcal{J}_{k,M_k}$ by applying mean shift clustering to the set $\{t_n \mid \boldsymbol{x}_n \in \mathcal{R}_k\}$. For mean shift clustering in time-domain, we use the variable bandwidth mean shift [Comaniciu and Meer 2002] to determine the kernel bandwidth for each data point adaptively.

We now present a visual analysis method satisfying our aim. First, we visualize each spot $\mathcal{R}_k$ as a rectangular prism called a *base* that is located on a map, where its height indicates the number V_k of visitors to $\mathcal{R}_k$ in the whole period $\mathcal{J}$. We measure the *burst degree* of each season $\mathcal{J}_{k,m}$ for $\mathcal{R}_k$ as $B_{k,m} = (V_{k,m}/V_k)/(|\mathcal{J}_{k,m}|/|\mathcal{J}|)$, where $V_{k,m}$ is the number of visitors to $\mathcal{R}_k$ in $\mathcal{J}_{k,m}$. Next, in order to analyze seasonal characteristics of each spot $\mathcal{R}_k$ in terms of burstiness, we visualize each season $\mathcal{J}_{k,m}$ of $\mathcal{R}_k$ as a cylinder called a *fiber* that is put on the base of $\mathcal{R}_k$, where its height indicates $B_{k,m}$ and its colors show when the period $\mathcal{J}_{k,m}$ is. Here, by continuously changing hue on the basis of the HSV color model, we specify the color of an arbitrary day in the year.

Using the Japanese Flickr data in 2010, we have examined the effectiveness of the proposed method. Figure 1 shows the visualization result. We can easily observe how the burstiness differ according to the popular photo spots extracted, and discover the seasons of high burst degrees and the spots having them (see Figure 1(b)). We have also confirmed that the burst seasons discovered are really attractive periods by investigating the corresponding photos in detail.

References

Comaniciu, D., and Meer, P. 2002. Mean shift: a robust approach toward feature space analysis. *IEEE Transactions on Pattern Analysis and Machine Intelligence 24*, 603–619.

Crandall, D., Backstrom, L., Huttenlocner, D., and Kleinberg, J. 2009. Mapping the world's photos. In *Proceedings of the 18th International World Wide Web Conference (WWW'09)*, 761–770.

Lu, X., Wang, C., Yang, J., Pang, Y., and Zhang, L. 2010. Photo2trip: generating travel routes from geo-tagged photos for trip planning. In *Proc. of MM'10*, 143–152.

*e-mail: {t12m014, t12m023}@mail.ryukoku.ac.jp, {kumano, kono, kimura}@rins.ryukoku.ac.jp

Permission to make digital or hard copies of part or all of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for third-party components of this work must be honored. For all other uses, contact the Owner/Author.
SIGGRAPH 2013, July 21 – 25, 2013, Anaheim, California.
2013 Copyright held by the Owner/Author.
ACM 978-1-4503-2261-4/13/07