論文 / 著書情報
Article / Book Information

題目(和文)	
Title(English)	Spatiotemporal Analysis of Human Behavior in Urban Settings Based on Social Geotagged Photos with Emphasis on Differences Between Locals and Tourists
著者(和文)	DERDOURI Ahmed
Author(English)	Ahmed Derdouri
出典(和文)	学位:博士(学術), 学位授与機関:東京工業大学, 報告番号:甲第12251号, 授与年月日:2022年9月22日, 学位の種別:課程博士, 審査員:大佛 俊泰,藤井 晴行,鍵 直樹,斎尾 直子,沖 拓弥
Citation(English)	Degree:Doctor (Academic), Conferring organization: Tokyo Institute of Technology, Report number:甲第12251号, Conferred date:2022/9/22, Degree Type:Course doctor, Examiner:,,,,
学位種別(和文)	博士論文
Category(English)	Doctoral Thesis
種別(和文)	論文要旨
Type(English)	Summary

（博士課程）
Doctoral Program

論 文 要 旨

THESIS SUMMARY

系・コース： Department of, Graduate major in	Architecture and Building Engineering 系 コース	申請学位（専攻分野）： Academic Degree Requested	博士 Doctor of (Philosophy)
学生氏名： Student's Name	Ahmed DERDOURI	指導教員（主）： Academic Supervisor(main)	Toshihiro OSARAGI
		指導教員（副）： Academic Supervisor(sub)	

要旨（英文 800 語程度）
Thesis Summary（approx.800 English Words ）

Several domains, including urban planning, tourism, and disaster response management all require a thorough understanding of the differences in mobility patterns of locals and tourists over time and across space. This is especially important in tourism-dependent and disaster-prone cities. Existing studies, however, often focus only on residents' behaviors and overlook those of foreign visitors primarily due to the lack of high-resolution spatial data. In this study, we investigate human mobility behaviors during stable and unstable conditions using geotagged photos taken from 2008 to 2019 in Tokyo, focusing mainly on disparities between locals and tourists. For the sake of simplicity, the term "locals" refers to Japanese nationals while "tourists" describes foreigners other than Japanese.

Chapter 1 presents an overview of the importance of understanding the differences in mobility behaviors of locals and tourists, especially in tourism, urban planning, and disaster response management. Moreover, it underlines the advantages of social geodata over traditional sources. The chapter proceeds by reviewing studies that have dealt with such a topic. Next, it highlights the main questions addressed in light of the literature gaps. Finally, it provides the dissertation outline.

Chapter 2 provides an overview of Tokyo and justifies its selection as a suitable target area for the research. It specifically sheds light on the characteristics of Tokyo focusing on its geographic settings, tourism characteristics, and past natural disasters. The chapter proceeds by highlighting the main data sources used. Finally, it explains the collection procedure.

The main objective of Chapter 3 is to develop a machine learning (ML)-based method capable of distinguishing between locals and tourists-providing more accurate results than those proposed in the literature. While previous studies rely on heuristic and probabilistic approaches, we propose a method for classifying the two groups based on ML algorithms and considering parameters that could explain the variability between the two (e.g., weather, mobility, and photo content). The approach is applied to Flickr users' geotagged photos taken in Tokyo from July 2008 to December 2019. The performance of built models based on six supervised-learning algorithms is compared and variables' importance is discussed. Insights on differences between the two groups are highlighted. These differences are further analyzed in Chapters 4 and 5.

Chapter 4 aims to explore the disparities between locals and tourists in terms of their spatial and temporal distribution using linear models combined with deep learning techniques. Initially, locals and tourists were identified using the proposed method in Chapter 3. Next, we developed a transfer learning-based convolutional neural network (CNN) model to multi-label photos into eight general categories reflecting the major frequented activities/locations. Additional information was assigned to these records including distances to various nearest points of interest. Qualitative and quantitative methods were used to investigate the differences between the two groups in different seasons and circumstances. These include statistical analyses using the Chi-square and ordinary least squares, semantic analyses of the most visited places, and mapping of spatial and temporal distributions.

In contrast to Chapter 4, Chapter 5 proposes a non-linear model for comparing locals and tourists in terms of their urban mobility characteristics. Specifically, a time series-based complex network analysis is used. Two mobility proxies are used, namely the itinerary total times and traveled distances of which their annual, monthly, weekly, and daily time series are calculated and converted to networks using the

Horizontal Visibility Graph algorithm. Next, a node degree distribution $N(k)$ analysis is conducted followed by the calculation of the scaling parameter λ of $N(k)=e^{-\lambda k}$. We employed the assumption that suggests the critical value $\lambda c=ln(3/2)$ differentiates between stochastic ($\lambda > \lambda c$) and chaotic ($\lambda < \lambda c$) dynamics. In other terms, the more stable and predictable the system is, the higher λ of the exponential degree distribution. Finally, weather effects are evaluated by applying the approach to samples taken during bad and ideal conditions.

Chapter 6 analyzes the impacts of various extreme natural events that affected Tokyo's human movement patterns between 2008 and 2019 based on geotagged photos. First, six disasters of different types are selected according to severity, damage, and photo count. Next, three phases representing steady and perturbed conditions (before, during, and after) are delineated for each extreme event based on relevant weather measurements. Then human mobility patterns are analyzed via two indicators: displacement and mean squared displacement. A CNN model is developed to classify the photos according to whether they were taken indoors or outdoors. Thus, the characteristics of people's trips within and between the two environments are investigated.

Chapter 7 summarizes the dissertation by providing the main findings and conclusions; details the contributions; points out limitations; and traces possible future research paths.