**Exploring Multi-Scale Spatiotemporal Twitter User Mobility Patterns with a Visual-Analytics Approach**

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**Abstract**

Understanding human mobility patterns is of great importance for urban planning, traffic management, and even marketing campaign. However, the capability of capturing detailed human movements with fine-grained spatial and temporal granularity is still limited. In this study, we extracted high-resolution mobility data from a collection of over 1.3 billion geo-located Twitter messages. Regarding the concerns of infringement on individual privacy, such as the mobile phone call records with restricted access, the dataset is collected from publicly accessible Twitter data streams. In this paper, we employed a visual-analytics approach to studying multi-scale spatiotemporal Twitter user mobility patterns in the contiguous United States during the year 2014. Our approach included a scalable visual-analytics framework to deliver efficiency and scalability in filtering large volume of geo-located tweets, modeling and extracting Twitter user movements, generating space-time user trajectories, and summarizing multi-scale spatiotemporal user mobility patterns. We performed a set of statistical analysis to understand Twitter user mobility patterns across multi-level spatial scales and temporal ranges.

In particular, Twitter user mobility patterns measured by the displacements and radius of gyrations of individuals revealed multi-scale or multi-modal Twitter user mobility patterns.

By further studying such mobility patterns in different temporal ranges, we identified both consistency and seasonal fluctuations regarding the distance decay effects in the corresponding mobility patterns. At the same time, our approach provides a geo-visualization unit with an interactive 3D virtual globe web mapping interface for exploratory geo-visual analytics of the multi-level spatiotemporal Twitter user movements.

**Keywords:** Geo-located tweets, mobility patterns, multi-scale spatiotemporal analysis, scalable visual-analytics framework

1. **Introduction**

Understanding human mobility patterns is of great importance for a broad range of applications from urban planning [1], traffic management [2], and even the spatial spread of epidemic diseases [3]. Earlier research efforts relied on low-resolution mobility data to understand human mobility patterns, such as using census records to study human migration patterns [4], or delivering questionnaires and asking volunteers to report the track of bank notes to infer human travel patterns [5]. However, such mobility data do not provide detailed human movements with fine-grained spatial and temporal granularity, which are usually aggregated and therefore are limited to capture mobility patterns of individuals [6,7]. In addition to the mobility data collected by GPS trackers [1,8] and mobile