Request for Research Funding for FY 2019-2020			
Requesting Office	FTO/D4	**Priority**	4 of 7
Proposed Title	Exploring the Potential of Smartphone GPS Data for Travel Demand Modeling		
Justification	Effective planning and infrastructure investments rely on the ability to assess future needs of the transportation system today. Data that capture people's travel characteristics and the tools used to analyze the data are the keys to safeguard the capabilities to produce long-term travel demand forecasts. Travel demand modeling and policy analysis have traditionally relied on data obtained from household travel surveys, which suffer from low response rate, high cost, and long gaps between data collection. The emergence of new data sources via passive collection methods, such as smartphone global positioning system (GPS) data and location-based service (LBS) data, present new opportunities to capture travel patterns and monitor system performance. These data can be obtained on a continuous basis with minimum burden, which helps transportation professionals better understand people's movement through space and time. It also enables further analysis of many elements of travel behavior that are not possible with traditional cross-sectional household travel survey data, such as the rhythmic patterns and variability in travel behavior, and the equilibrium and dynamics in travel choices. In a world that is fast changing with rapidly evolving technologies and mobility options, the ability to capture emerging trends and predict future patterns becomes crucial to inform policy and investment decisions. Passively collected data via smartphone GPS and LBS have the potential to deliver individual travel characteristics vital to travel demand modeling, for the whole region without participation burden in near real-time on a continuous basis. However, there are a few challenges associated with the data that are still not fully explored. These issues include the lack of demographic information, missing detailed trip attributes such as purpose and joint travel, individual vs. household level representation, and privacy concerns and battery issues that may affect participation. This project aims to explore smartphone GPS data in terms of the practicality of capturing, managing and processing the data required for travel demand modeling. Innovative data mining and fusion techniques will be utilized to address the above issues. Additional data sources (such as parcel level land use data, Census data, street networks, and general transit feed specification (GTFS), etc.) will be integrated to help identify user segments and their behavioral contexts for the patterns observed from GPS trace data. The major tasks to be accomplished through this project include: 1. Develop a mobile app that retrieves individual's GPS location information. A smart adaptive algorithm will be used to decrease or increase the frequency and/or the accuracy of location requests based on changes of travel modes, thereby minimizes the power usage of the mobile device. 2. Develop a data processing tool that reconstructs place, trip and tour logs based on the GPS trajectories. Integrating spatial point of interest data and network data, clustering methods using both temporal and spatial attributes and network based spatial-temporal probability analysis will be used to detect fixed locations, location type and activity purpose, moving speed, time and routes. 3. Recruit participants and obtain smartphone GPS information. Recruitment through marketing survey firms provides the opportunity to obtain demographic information and monitor sample completion according to designed sample plan. 4. Investigate travel characteristics and behavioral dynamics of individual travel pattern and explore approaches to construct household level travel profiles. The possibility of deriving demand forecasts directly from personal travel information will also be explored. Through this feasibility study, a prototype tool will be developed to retrieve and process individual GPS data on the server side before transmitting to the user end for further analysis, which may help address privacy concerns and enhance participation rate. Detailed location and travel information will be collected from a small portion of the sample for validation purpose. Analysis results will also be compared withNHTS and household survey results. This project will help us better understand the challenges and potential solutions to tap into the full potential		

	of individual's GPS data or similar data, and provide an opportunity to advance our knowledge in travel behavioral dynamics and support travel demand analysis and forecasting.		
Impact	This project explores smartphone GPS data in terms of the practicality of capturing, managing and processing the data required for travel demand modeling. The algorithm and process can be applied to similar data sources, such as LBS data, social media, CAV trajectories, etc. The insights from this project can help identify more cost-effective ways to obtain travel characteristics with higher spatial and temporal precision at a large scale on a continuous basis to inform travel demand modeling. These data sources have the potential to save state and MPOs substantial funding, time and efforts in data collection and model development.		
Affected Offices	Forecasting and Trends		
Existing Work	The Transportation Research International Documentation (TRID, https://trid.trb.org/Results) and the Research in Progress (RIP, https://rip.trb.org/) online databases were checked thoroughly. A review of the literature indicates that very few studies have focused on cellphone GPS data, most existing studies are based on either GPS data or the mobile network data. Nevertheless, these studies still provide valuable insights in terms of data processing algorithm and potential applications. A major challenge of passively collected data is that there is no participant input, so the researchers mainly rely on data mining techniques to derive useful information that could help describe people's mobility patterns.		
Keywords Used In Existing Work Search	Smartphone GPS data, mobile phone data, location-based service data		
Related Contracts (Give contract numbers)	n/a		
Funding Request	$200,000	**Anticipated Duration**	18 months
Project Manager	Hui Zhao, P.E. Planning and Environmental Management Florida DOT - District 4 Phone: (954) 777-4635 Email: Hui.Zhao@dot.state.fl.us	**Contracting Method**	Direct contract with university
Urgency	1= highest , most immediate need	To support the increasingly complex planning activities, many agencies are facing the challenges of obtaining highly nuanced travel behavior data while managing shrinking financial resources. Recent advancements in smart phones and GPS technologies present new opportunities to track people's movement through time and space.	
Implementability	1=greatest likelihood of and proximity to implementing results	This project will develop a prototype tool to retrieve and process smartphone GPS data and derive personal travel pattern information needed for travel demand modeling. It can be applied to similar data sources and be implemented by other agencies and regions in the nation.	

Project Benefits (Succinct, complete explanation)

Traditional data acquisition methods for travel demand modeling and policy analysis, via surveys and travel diaries, have become more burdensome and inefficient, while passively collected data, such as smartphone GPS data, have the potential to deliver individual travel characteristics with better temporal and spatial precision at large scale with low cost.

This project explores smartphone GPS data in terms of the practicality of capturing, managing and processing the data required for travel demand modeling. This project will help us better understand the challenges and potential solutions to tap into the full potential

of individual's GPS data. This project also provides an opportunity to fill in the data gap and facilitate the investigation of various issues, including: lack of data for less frequent long-distance travel, limited data to represent non-home-based travel, lack of speed data for lower functionally classified roadways, limited data to understand multimodal travel particularly in small urban areas, and tourism, recreational and seasonal travel that are important in Florida.		
Project Benefits **(Select all that apply and explain)**	**Quantifiable Benefits (units, dollars, etc…if applicable)**	**Methodology or Data Sources Used to Determine Quantifiable Benefits. If not applicable, please give justification of project benefits**
o Materials Enhancement		
o Materials Savings		
o Time Savings		
o Lives Saved/Injuries Prevented		
o Other (Explain)	Informed and better decisions on transportation policy and investment	The insights from this project can help identify more cost-effective ways to obtain travel characteristics with higher spatial and temporal precision at a large scale on a continuous basis to inform travel demand modeling. These data sources have the potential to save state and MPOs substantial funding, time and efforts in data collection and model development.

*Comments should explain and support urgency, financial benefit, and implementability scores