1. RESEARCH AIM & OBJECTIVES

The safety performance of United States of America (U.S.A.) roadways has been relatively stagnant over the last eight years for injury-related crash rates, remaining in the mid-70s for injury rate per 100 million vehicle miles traveled, and slightly down for fatality-related crashes rates, a decrease of 0.07 fatalities per 100 million vehicles miles traveled (US Department of Transportation (USDOT) 2016 and National Highway Traffic Safety Administration (NHTSA)). The overall focus in major metropolitan areas is improving the operations as travel volumes continue to increase on the major highways surrounding these metropolitan areas. With every new operational strategy, the safety effects are typically analyzed to ensure the roadway safety is, at least, negligibly affected. Part-time shoulder use (PTSU) is an operations improvement strategy that has mixed expectations from transportation agencies on its effects on safety. PTSU utilizes the shoulder as an additional lane during high congestion periods, typically during commuting time where there are high levels of congestion, typically around metropolitan areas. As the use of this strategy is still growing, the majority research on the safety effects are theoretical or field case-studies. In high population density areas, as roadway expansion becomes increasingly difficult, optimizing the current roadway infrastructure will become a more significant focus of maintaining the roadway system. PTSU is one of the major strategies that can significantly improve the operations of these roadway and additional knowledge of PTSU is needed for improved applications in the future. In the implementations that have occurred around the world, the safety effects have been negligible to partially beneficial (Geistefeldt 2012 and Kuhn et al 2013). There is still an overall concern as there is a loss of the emergency travel lane or an emergency refuge area if a vehicle breaks down. Typical PTSU implementations recommend periodic refuge areas for broken down vehicles. This study aims to explore the extent of PTSU application effects on the roadway safety, including cases when there is a partially blocked lane due to an incident. This study is focusing on a microsimulation methodology to evaluate PTSU on a roadway in Southeastern Pennsylvania that is expected to utilize PTSU in the future according to the Delaware Valley Regional Planning Commission (DVRPC) 2040 plan (DVRPC 2013). The final aim is to further understand PTSU in the U.S. to improve future application of this operational strategy.

2. METHODS

Microsimulation model Vissim is applied to estimate safety effects of PTSU under various scenarios. Using individual vehicle trajectory data from Vissim will then be assessed through the Surrogate Safety Assessment Model (SSAM) to provide safety parameters to gauge the overall safety of the roadway.
The scenarios being analyze include the base scenario, the base PTSU scenario, the base scenario with a lane blocking crash, and PTSU with a lane blocking crash. Each crash scenario will be evaluated with a crash occurring between each interchange, at each interchange, and in various lanes within the model network. This approach will provide an overall understanding of crashes’ impacts on the network performance when there is a partially blocked lane. The overall flow of this study is shown below in Figure 1.

![Overall Research Flow Chart](image)

**Figure 1: Overall Research Flow Chart**

### 3. EXPECTED RESULTS

Using the time-to-collision and post encroachment time, since they approximate the possible crash occurrence, not actual crashes, the safety performance determined from the individual vehicle trajectory data from Vissim will be a probability safety performance. Depending on the value of the safety parameters, there will be an increased or decreased probability of a crash. The probabilistic safety performance will provide a distribution of the vehicles that were likely to crash in the network and will be divided into the different severity levels. The safety performance distributions will be compared across the variety of scenarios to highlight the change in the overall safety performance.

### 4. FUTURE RESEARCH

This is an on-going research project to develop a holistic approach to assess PTSU as it is utilized more often in the U.S. The research is focusing on the effects of PTSU on the traffic operation, safety, and pavement infrastructure. This research, while on-going, is nearing its completion in the Summer of 2017. As the use increases to relieve congestion, the need of PTSU will increase. This research aims to improve the knowledge on PTSU in the U.S. to provide an improved understanding of this strategy.

### REFERENCES


