

# Monitoring of Transportation System Assets using Synthetic Aperture Radar (SAR) Satellite Data

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Tran-SET

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**Total Project Cost:**

\$ 140,000

*Using SAR Satellite data to monitor transportation system assets*

Condition data of transportation assets is of prime importance for effective allocation and utilization of resources for operating, maintaining, and upgrading ageing assets throughout its lifecycle. The federal regulations, as a part of Transportation Asset Management (TAM) plan, mandates state DOT's to annually and/or biennially inspect certain assets – bridges and pavement, and encourages inspection of other assets – walls, slopes, embankments, and subgrades within the pavement Right-of-Way (ROW). Dearth of inventory data, condition data, and performance measures of various assets within the pavement's ROW has limited the scope of current TAM applications. The main intent of this research project is to evaluate the possibility of use of orbital Synthetic Aperture Radar (SAR) satellite data for condition assessment and performance monitoring of transportation assets. If successful, SAR data can be used to effortlessly extend the current TAM scope as well as increase the monitoring frequency of assets as needed (additional surveys can be done during inclement weathers, natural disasters, and other hazard events).

**Problem Statement**

Spaceborne SAR is a remote sensing technology that have been extensively used to monitor large spatial area at low cost – primarily used in landslide and tailings monitoring in civil engineering domain. Despite a wide acceptance in geosciences /geomatics community in last 15 years, very limited research was available on its application for monitoring transportation assets in the US. Majority of these research studies were championed by Virginia Transportation Research Council (VTRC) and have shown initial technical and economic feasibility of SAR data for network wide monitoring of transportation asset. The aim of this research is to build on the limited existing literature by comprehensive analysis of medium and high-resolution SAR data for asset monitoring and comparing it with ground truth information. Information extracted from processed SAR data closely aligns with the type of data that is typically used in asset management of transportation

systems as mentioned in FHWA 23 CFR Part 490 and NCHRP Research Report 903 Vol 2. A wide spatial coverage, i.e., beyond a typical ROW, and high temporal resolution, i.e., every 6 days for medium resolution and <1 day for on-demand high resolution, in contrast to current practice of annual inspection, SAR surveys will enable the DOTs to examine the performance of assets before and after extreme weather, flooding event. Region 6 is prone to devastating hurricanes every year which imparts significant stresses on the pavements. During such an event, SAR systems can be deployed at a moment's notice to get information on infrastructure conditions irrespective of cloud cover and presence of sunlight with turnaround of 2-3 hours (based on current number of satellites in a constellation and likely to decrease with time). Such information can be valuable not only for TAM plans but for emergency responses as well. Therefore, it is imperative to understand the relationship between radar backscatter and condition of a transportation asset. This research project will focus on evaluation of the application of medium and high-resolution SAR satellite data in assessing the condition and performance of pavements and adjacent infrastructure assets.

**Objectives**

The objectives for this research project are: 1) To identify the health and performance metrics of assets in transportation system that is essential for TAM; 2) To study SAR technology, and then collect SAR surveys data to evaluate the SAR studies for reliable evaluation of asset condition; and, to determine a relationship between TAM metrics and SAR processed data for pavements; 3) To develop a workflow and a road map with SAR as a tool for assessing pavement and other infrastructure conditions.



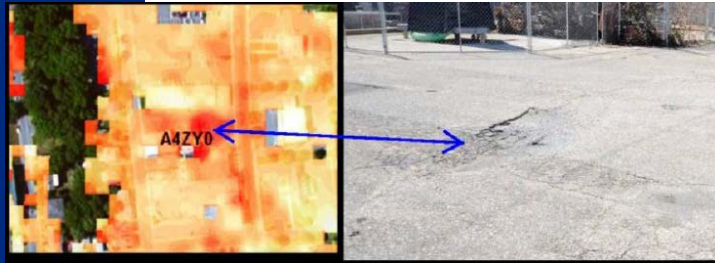


Figure 1. Surface distress due to sewer line breakage (right) identified in the InSAR time series data (left)

## Intended Implementation of Research

The final report from the study will include a summary of the current state of practice in TAM plan across southcentral states with respect to monitoring the condition of transportation system assets and support the potential use of state-of-art technologies like SAR in condition assessment. The results of the study will also be shared in Web GIS that will further encourage active participation and involvement of stakeholders even after the completion of the project. This will be hosted in ArcGIS Online with Texas A&M University and will be accessible to public. Additionally, the findings of this research will be disseminated through presentations at local, regional, national, and international conferences and symposiums. An effort will also be made to present the finding of this study to state DOTs and agencies responsible transportation assets during their monthly meetings. A simplified version of this research will made for events like annual science festivals at local high school.

## Anticipated Impacts/Benefits of Implementation

The findings of this research will result in better transportation infrastructure asset management for the states in the South Central area and all other States. Infrastructure asset management is always challenging in these regions due to problematic soils and constant natural hazards. This study and results will be of tremendous value to this region.



## Web links

- Tran-SET's website  
<https://transet.lsu.edu/research-in-progress/>

## Tran-SET

Tran-SET is Region 6's University Transportation Center. It is a collaborative partnership between 11 institutions (see below) across 5 states (AR, LA, NM, OK, and TX). Tran-SET is led by Louisiana State University. It was established in late November 2016 "to address the accelerated deterioration of transportation infrastructure through the development, evaluation, and implementation of cutting-edge technologies, novel materials, and innovative construction management processes".

## Learn More

For more information about Tran-SET, please visit [our website](#), LinkedIn, Twitter, Facebook, and YouTube pages. Also, please feel free to contact Dr. Momen Mousa (Tran-SET Program Manager) directly at [transet@lsu.edu](mailto:transet@lsu.edu).