Exhibit D

Research Project Submission Template

Recipient/Grant (Contract) Number: University of Illinois Urbana-Champaign / Grant No.: 69A 355 234 8333

Condition Assessment of Transportation Infrastructure using Space-Borne Sensors and AI

Center Name: Transportation Infrastructure Precast Innovation Center (TRANS-IPIC)

Research Priority: Improving the Durability and Extending the Life of Transportation Infrastructure

Principal Investigator(s): Bassem Andrawes

Project Partners: N/A

Research Project Funding: $105,000 ($70,000 Federal and $35,000 Non-Federal)

Project Start and End Date: 01/16/2026 – 01/15/2027

Project Description:

This proposal focuses on developing a new framework for utilizing space data routinely acquired using satellites to make an accurate assessment of the structural condition of bridge infrastructure in the U.S. The proposed framework will be developed using high-resolution Multi-Temporal Interferometric Synthetic Aperture Radar (MT-InSAR) satellite images, advanced structural analysis, environmental data, and data driven AI models. MT-InSAR analysis is capable of capturing small movements of bridges at a scale of a few millimeters, a feature that will be utilized in this research. The project represents an important step towards developing a framework for a National infrastructure assessment system based on monitoring bridge movements in near real-time. This project will help: (1) advance the knowledge and overcome challenges related to time series analysis of satellite images for bridge monitoring, and (2) develop a structure-based data-driven ML system that can be used for providing near real-time "quantitative" continuous assessment of bridge networks.

US DOT Priorities:

According to the National Academy of Engineering (NAE), urban infrastructure restoration and improvement are among the greatest challenges facing 21st-century engineers (NAE, 2018). Transportation infrastructure systems are among the most critically needed lifelines for the survival of our society. The ever-growing societal demands on these systems, in addition to their continuous aging and deterioration due to weather and other service conditions, impose severe threats to our Nation. According to the American Road & Transportation Builders Association, there are over 54,000 bridges in the U.S. (approximately 9% of total bridges) that are structurally deficient and need repair. Although one can specify several reasons for the inferior condition that the U.S. infrastructure has reached, there is a key problem that is quite critical, hence will be addressed in this TRANS-IPIC proposal: Lack of Effective Global Infrastructure Data Resources in the U.S. We are currently living in a time where data plays a key role in all fields of life. When it comes to transportation infrastructure, there is a major problem with finding, acquiring, and organizing the massive data produced every day on our roads, bridges, tunnels, etc. In a world with limited economic resources, making quick, well-informed decisions becomes critically important and could, in some cases, make a difference between life and death. Unfortunately, currently, the common means for creating data related to the health of our transportation infrastructure is primarily through traditional routine human inspections, which delays the process and overburdens highway agencies financially. The National Bridge Inspection Standards (NBIS) require bridges to be inspected once every two years. These discrete inspections are by no means sufficient to capture the true condition of the infrastructure at any given point in time, which could lead to missing crucial information. We strongly believe that there should be a more cost-effective, robust, and reliable way through which

decision makers can be continuously informed about the health and condition of transportation infrastructure. This proposal will focus on utilizing freely acquired satellite data (remote sensing) to inform bridge owners and stakeholders on the condition of their transportation assets. This will facilitate developing intervention plans for maintenance, repair, or replacement, and implementing these plans at the right time. The proposed research will help address the main challenges facing this remote sensing technology and how precast concrete (PC) components used in transportation infrastructure could be fabricated with built-in satellite detection capabilities. The proposal aligns with the TRANS-IPIC and U.S. DOT goals as it will help in advancing the safety and durability of transportation infrastructure.

Outputs:

This proposal lays out a vision and a plan for developing a new disruptive technology that will employ the massive data collected routinely from space by satellites orbiting the Earth to inform us about the health condition of transportation infrastructure in the U.S. The proposed research will provide, through the use of unsupervised machine learning, a framework for performing near real-time spatial structural assessment of precast concrete (PC) and steel bridges. The project will shed light on the main challenges facing this new technology, especially concerning the free data availability and resolution, as well as the accuracy of the MT-InSAR analysis in capturing the bridge deformations under thermal and traffic loads. The project will help us understand the factors that impact the detection of PS reflective points on bridges with different PC components (beams, barriers, panels, etc.). The framework developed in this project will provide bridge owners with an early warning tool that can keep them informed about the condition of their bridges, which will in turn help extend the life and advance the safety of bridge assets.

Outcomes/Impacts:

The results of this research will provide the industry with the first set of data on the feasibility of using freely distributed satellite imagery data to assess the condition of bridges in the U.S. The project will develop an implementable framework for transportation agencies to adopt. The steps for implementing the proposed framework (e.g., sources of data, software for analyzing satellite images, parameters used in bridge analysis, input data for machine learning tools, etc.) will be shared and described in detail with example case studies on actual bridges in the U.S. in the final project report.

Final Research Report: URL link to the project's final report will be provided upon the completion of the project.