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Computer Vision Based Imaging and Characterization of Transportation Geomaterials

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Extended Abstract

An accurate characterization of size and shape properties of geomaterials is essential for assessing construction quality and performance trends of roads, railways and airfields, as built transportation infrastructure. The composition and packing, layer stiffness, and load response are all influenced by the morphological characteristics of granular soils and aggregates. A convenient and affordable system for acquiring aggregate morphology information from stockpiles and constructed layers in the field has been developed at the University of Illinois as an innovative 3D imaging approach, whereby engineers can perform inspection by taking high resolution videos/images with mobile devices such as smartphone cameras and automated scanning vehicles. Such a ballast scanning vehicle (BSV) recently developed utilizes a deep learning-based pipeline for image segmentation to evaluate task-specific metrics such as coarse aggregate gradation, Fouling Index (FI), and continuous railroad track FI depth profiles.

Based on the field results, the BSV is capable of providing accurate and near real-time evaluation of in-service ballast conditions, serve as a robust means for inspecting long sections of track, and can be used to investigate persistent trouble-spots related to track performance. The computer vision based imaging approach also leverages Structure-from-Motion (SfM) techniques to reconstruct the stockpile surfaces as well as depth-profile aggregate layers as 3D spatial data, i.e. point cloud, and uses a 3D segmentation algorithm to separate and extract individual aggregates from the reconstructed stockpile.

The preliminary results to be presented demonstrate the future potential of using 3D aggregate size and shape information for onsite Quality Assurance/Quality Control (QA/QC) tasks.