UTC Project Information	
Project Title	Automated Localization and ADA Functional Condition Assessment of Curb Ramps using Mobile Lidar
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Funding Source(s) and Amounts Provided (by each agency or organization)	University of Washington PacTrans $40,000 Oregon State University $ 40,000
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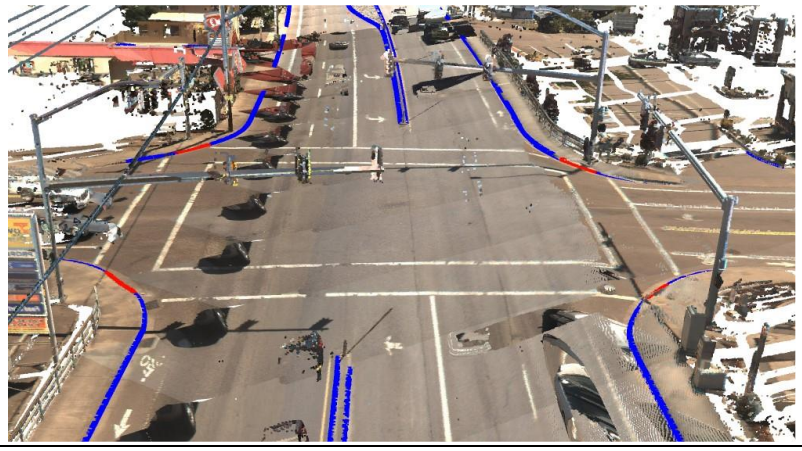
Brief Description of Research Project	Curb ramps are an essential component of a safe, accessible, and efficient mobility for all transportation users. To make sure the curb ramps can function as intended, design and construction should follow Americans with Disabilities Act (ADA) standards and guidelines, given that those with disabilities are most adversely affected by improper construction. Missing curb ramps as well as those that do not meet the requirements may cause accessibility barriers for persons with disabilities. One of the primary challenges that transportation agencies face is that assessing the quality of a curb ramp is time-consuming and labor intensive, especially since every corner at an intersection includes multiple curb ramps. Mobile lidar is a remote sensing technology that provides detailed 3D geometry information in the form of 3D point clouds that can be used to extract various characteristics and metrics to determine the ADA compliance of curb ramps. However, manual processing of mobile lidar data can often be tedious and time-consuming and requires specialized software and training. These barriers prevent agencies from using it for curb ramp ADA compliance assessment. Therefore, the research team developed an automatic workflow to extract and localize curb ramps in the large point cloud data. The proposed approach consists of three steps: ground filtering, curb detection, and curb ramp localization. The proposed approach can be potentially used for further analysis such as feature characterization and point cloud classification for other features.

Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	To validate the ramp localization approach proposed in this project, the team tested it using a dataset collected by Oregon Department of Transportation with a Leica Pegasus: Two mobile lidar system. The proposed approach consists of three steps: ground filtering, curb detection, and curb ramp localization. The research team adopted a novel ground filtering algorithm, Vo-SmoG, from their prior work. Next, the ground surface is modeled, and the curb line can be detected from that model based on the abrupt elevation difference and linearity. Lastly, a gap between two curb lines becomes a candidate curb ramp and is further screened based on the width and alignment of the associated curb lines. The proposed approach is demonstrated to be effective and efficient through a quantitative and qualitative analysis on a large mobile lidar dataset. The recall, precision, and F-1 score were all found to be 72.4% in terms of identifying the curb ramps from the point cloud data. Given the fact that the proposed approach results in a classified point cloud, in the future, the research team will leverage it to further classify and characterize more features for asset management and other applications. 
Impacts/Benefits of Implementation (actual, or anticipated)	The proposed novel framework will make it much more convenient and faster to assess curb ramp ADA compliance, thus improving the current practice in terms of both efficiency and safety. The developed algorithms help to identify and assess curb ramps in mobile lidar data automatically using feature extraction and segmentation techniques. The anticipated impacts/benefits of this research are 1) improved ADA compliance of curb ramps as a result of using the developed algorithm that enables to automatically identify curb ramps and assess their ADA compliance in mobile lidar data; 2) a guideline on the accuracy and reliability for utilizing mobile lidar data in curb ramp assessment; and 3) help increase the adoption of mobile lidar technology for transportation projects. All of these factors should help assist in maintaining U.S. transportation network in a state of good repair, thus helping ensure its safety, mobility and inclusiveness for persons with disabilities.
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