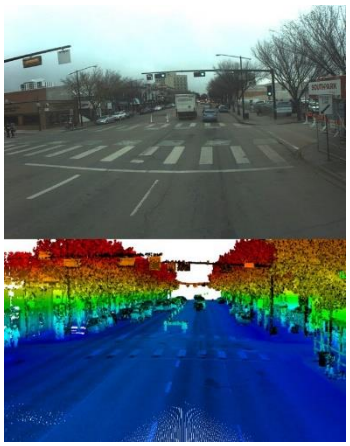
2020 Canadian ITS R&D/Innovation Award

The 2020 Canadian ITS R&D/Innovation Award recipient is "***Information Fusion in Detection, Recognition, and Classification of Road Infrastructure from Remote Sensing Data"*** submitted by the University of Alberta. Alberta Transportation sponsored the feasibility study (concluded in March 2018), and a potential application in noise modeling was explored with a Canadian industry partner through the NSERC Engage program (concluded in August 2018). Currently, the project is being conducted for the City of Edmonton.



Canada has more than one-million-kilometres of two-lane equivalent road with a subset of these roads designated as the National Highway System (NHS), a vital network of highways that maintain the economy and mobility of Canadians. To sustain these roles in economically challenging times, Canada's transportation authorities need to effectively audit important roadway features and design elements. Still, it is increasingly difficult to manually attain accurate information, highlighting a clear need for a more efficient and cost-effective process to survey and manage road infrastructure. Remote sensing technology makes it possible to obtain information about roadways at unprecedented scale and speed. Light Detection and Ranging (LiDAR) technology is a remote sensing technique with the potential to transform the surveying process through millimeter-level precision that enables different features to be measured at a high degree of accuracy. However, there are several challenges that have limited the use of this technology. Hence, there is a need to develop novel methods to extract valuable information from high-fidelity LiDAR data in a way that is more transparent and beneficial to the broader research community. Such information can be used to facilitate the development of an evidence-based and systemic asset management process. Better management of highway assets has been shown to enhance transportation safety and stimulate economic growth while connecting rural and remote communities. This research develops automated algorithms for inventorying and mapping road features from big LiDAR data. This work involves fusing multiple data sources (i.e., mobile laser scanners [MLS] and video logs) to extract contextual and semantic information about the road environment, thereby allowing road agencies to take actionable measures to improve safety and mobility on their road infrastructure. The proposed techniques are designed to reduce uncertainty in detection, recognition, and classification of on-road information (i.e., lane markings and road edges) and roadside information (i.e., traffic signs, trees, guardrails, utility poles) to assess geometric roadway features (i.e., sight distance, horizontal and vertical alignments). Once the data fusion is complete, the developed algorithms used the 3D point cloud to automate the detection and identification, thereby reducing the time consumption, labor intensity, traffic disruption, and costs associated with the manual collection of road information.

With these potential benefits in mind, the main goal of this program was to develop methods and algorithms using statistical pattern recognition and machine learning techniques to move from data to information (i.e., collecting it from multiple heterogeneous sources such as MLS and video logs and creating 3D representations of roadside features). The secondary goals were to convert the extracted information into knowledge (i.e., enriching the process of risk-based performance design and improving road infrastructure planning). The advantage of working with 3D point clouds is that it easily lends itself to data visualization. More so, the analytical methods developed through fusing the 3D point cloud with collision and other data (i.e., traffic, speed, etc.) will allow for both quantitative analysis, to promote a safety-based approach to design roads; and qualitative analysis, to assess the preparedness of existing infrastructure to accommodate future Connected and Automated Vehicle technologies. Fusing multiple datasets addresses the potential implications of missing, uncertain, or lost information, and lead to converting information into actionable knowledge by any road agency. Road authorities continuously maintain and upgrade road infrastructure across Canada. Their infrastructure portfolio includes a multibillion-dollar expenditure on the construction of new roads. To safeguard these investments, the proposed program facilitates the improvement of road

infrastructure, which are necessary to provide all road users with the facilities they need to move people and goods successfully, well into the future.