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Calibration of Phenomobile LiDAR System Using Vertical Target Boards and Utilizing a Modified Weight Matrix Based Approach

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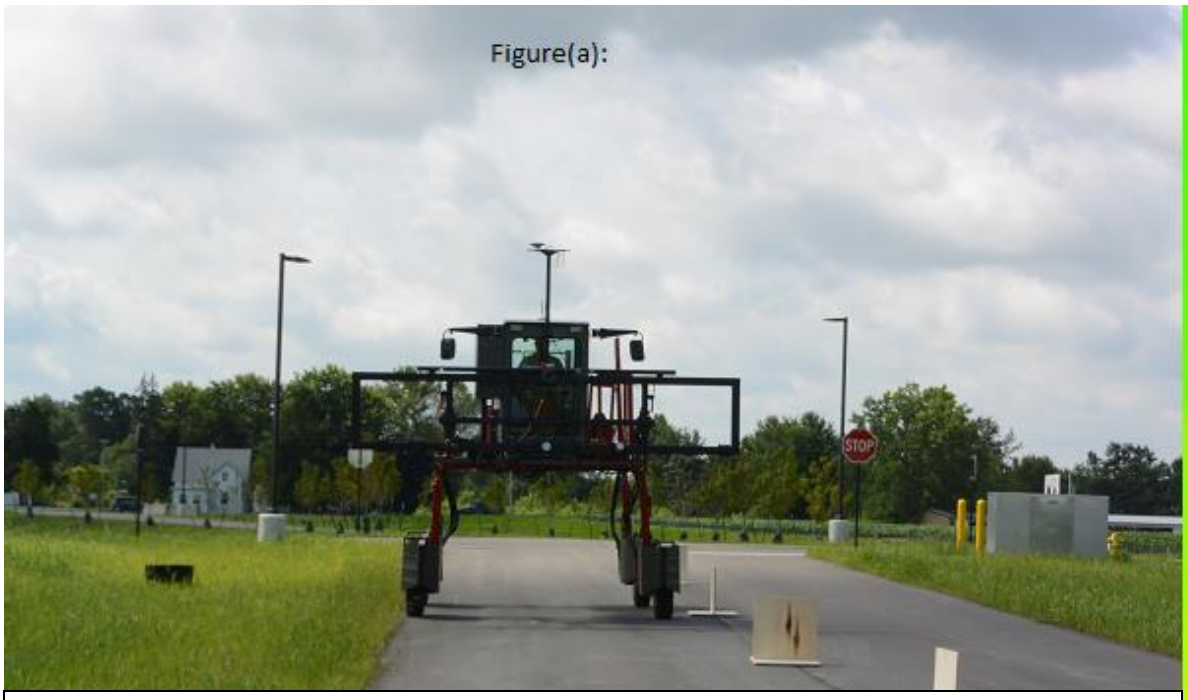

Figure (a): Phenomobile collecting data on the calibration track
(b): Top view of the calibration target boards in the processed point cloud

Overview: LiDAR system calibration is an important step in obtaining meaningful data from Mobile Terrestrial Mapping Systems (MTMS). In MTMS such as Phenomobile, a vehicle which is used primarily for collecting data from agricultural fields, it is difficult to use general calibration methods which require geometrically recognizable features (e.g; linear features) since they are not available on the field. To facilitate calibration, a set of target boards are arranged on the ground and a modified weight matrix approach is utilized to perform LiDAR system calibration.

Background: Phenotyping of crops such as corn and sorghum can be performed using LiDAR data, as LiDAR is capable of providing 3D point clouds with high accuracy. However, before we can collect meaningful data with MTMS, system calibration must be performed to remove systematic errors while the system is in motion and provide reliable measurements. The LiDAR sensor used for our data collection is Velodyne HDL-32E, and is integrated with Novatel IGM GNSS/INS sensor.

Methodology: To perform the calibration, we have used two ground planes and five vertical boards that are perpendicular to the adjacent boards. System calibration is performed by driving the phenomobile in opposite directions (tracks), and placing constraints on the extracted board points from different tracks using a modified weight matrix to force them to lie on the same plane.

Preliminary Results: Based on the performed initial calibration, the inference are as below:

- The calibration procedure yields good results with an accuracy in the order of 1 to 4 cm.
- The results seem to be affected by the accuracy of the GNSS/INS sensor whose accuracy is of the same order as the calibration output.
- There also seems to be noise in the data due to the laser beam hitting the sharp corners of the calibration board.

Scope for Future Work: Stability analysis on the system calibration is to be performed to validate the reliability of the extracted LiDAR sensor calibration parameters.