TREE HEIGHT CLASSIFICATION FROM LIDAR DATA

COURSE INSTRUCTOR : Dr.Dubacharla Gyaneshwar

PRESENTED BY:B.USHA NAGA SRI (CS22B1018)

INTRODUCTION

- **LiDAR (Light Detection and Ranging)**: A remote sensing technology that uses laser pulses to measure distances and create 3D point clouds.
- **Objective**: To classify tree height from LiDAR data to overcome limitations of traditional tree measurement methods (manual, expensive, slow).
- **Problem**: Traditional tree height measurement methods are not scalable or efficient for large forests.
- **Why LiDAR?**: Provides accurate, efficient, and non-destructive measurements.

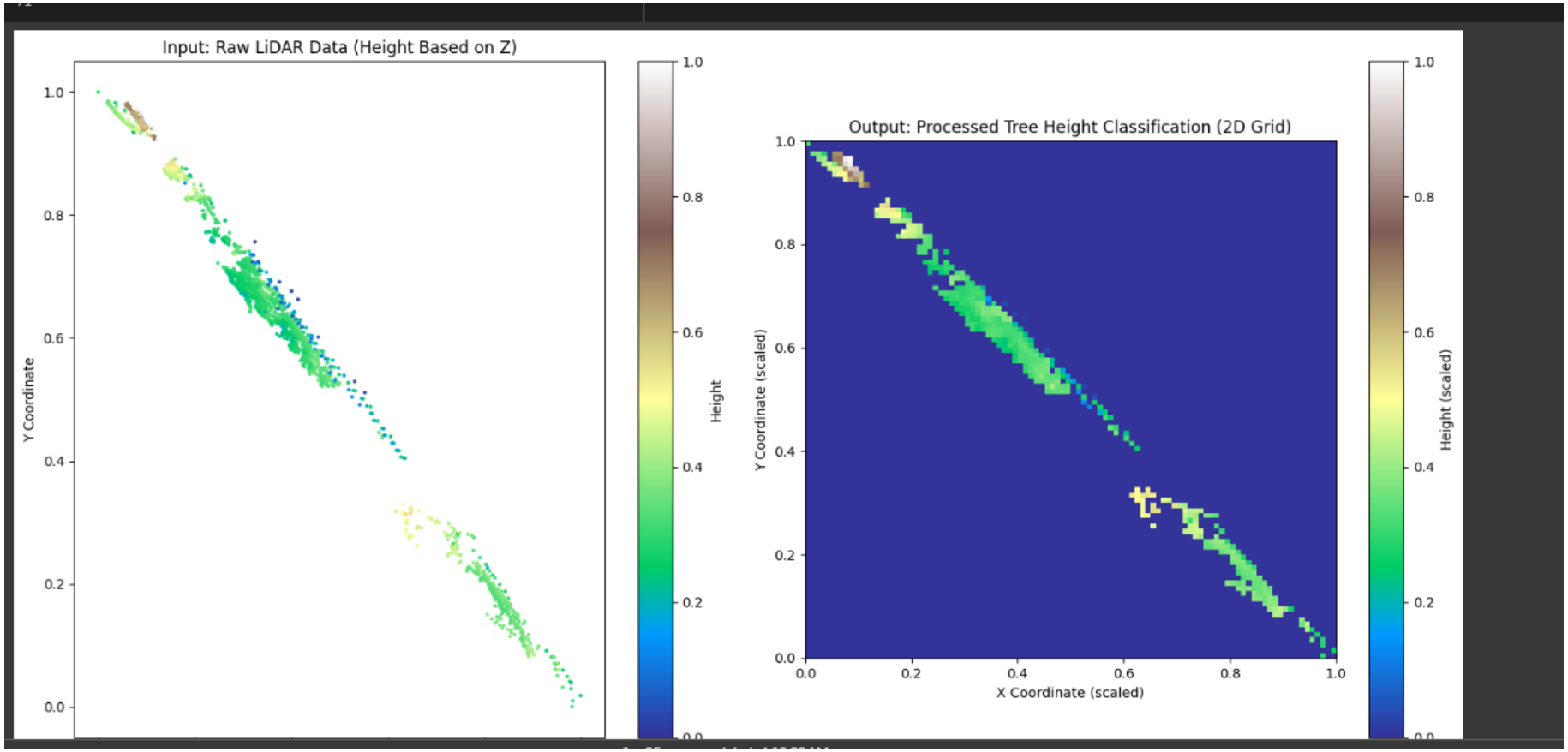
METHODOLOGY AND APPROACH

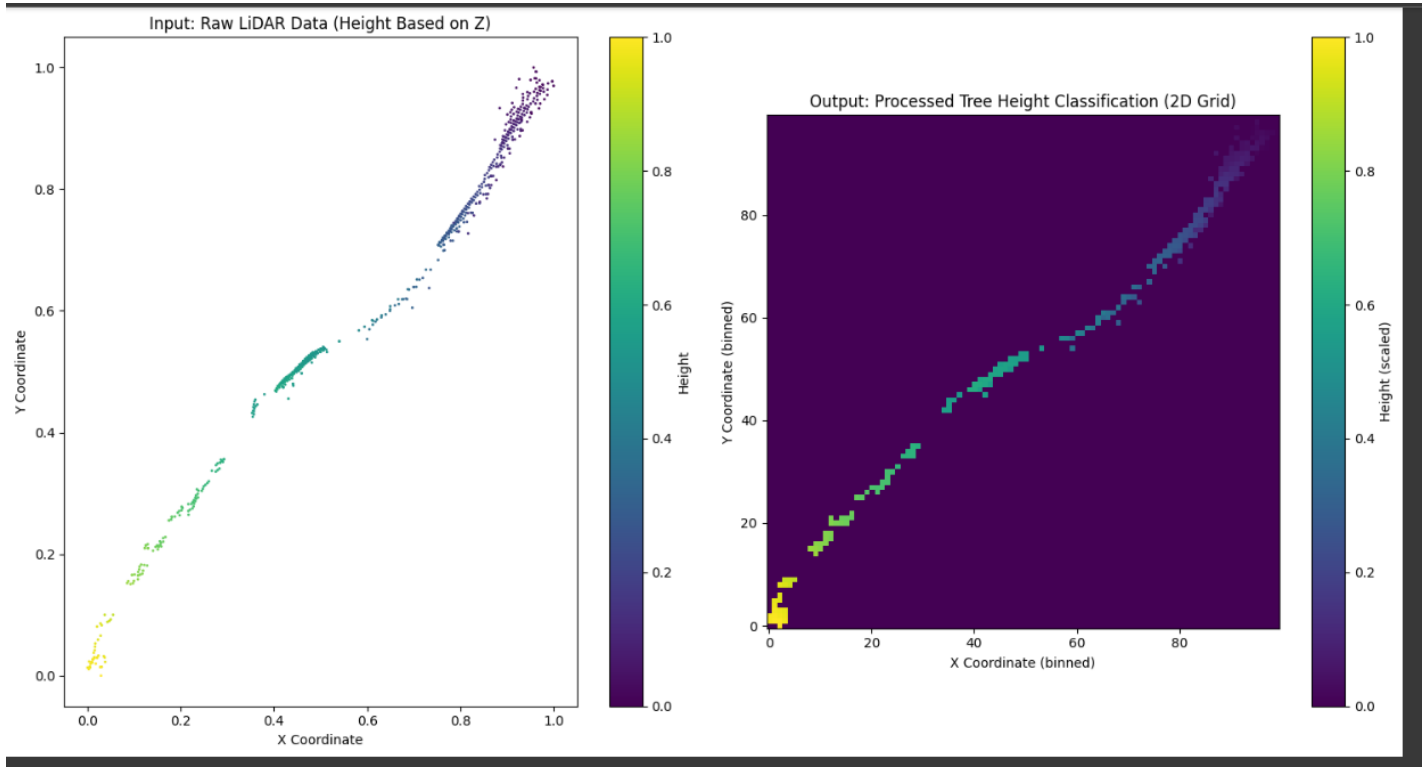
- **Step 1: Data Acquisition**
  - LiDAR point cloud data (from `.pcd` files).
  - Each point has `x`, `y`, `z` coordinates (3D points).
- **Step 2: Data Processing**
  - **Scaling**: Normalize `x`, `y`, and `z` to a range of `[0, 1]` using MinMaxScaler.
  - **Grid Creation**: Use 2D binning of `x` and `y` to calculate the maximum tree height within each grid cell.
- **Step 3: Visualization**
  - Visualize raw LiDAR data and processed tree heights using scatter plots and heatmaps.

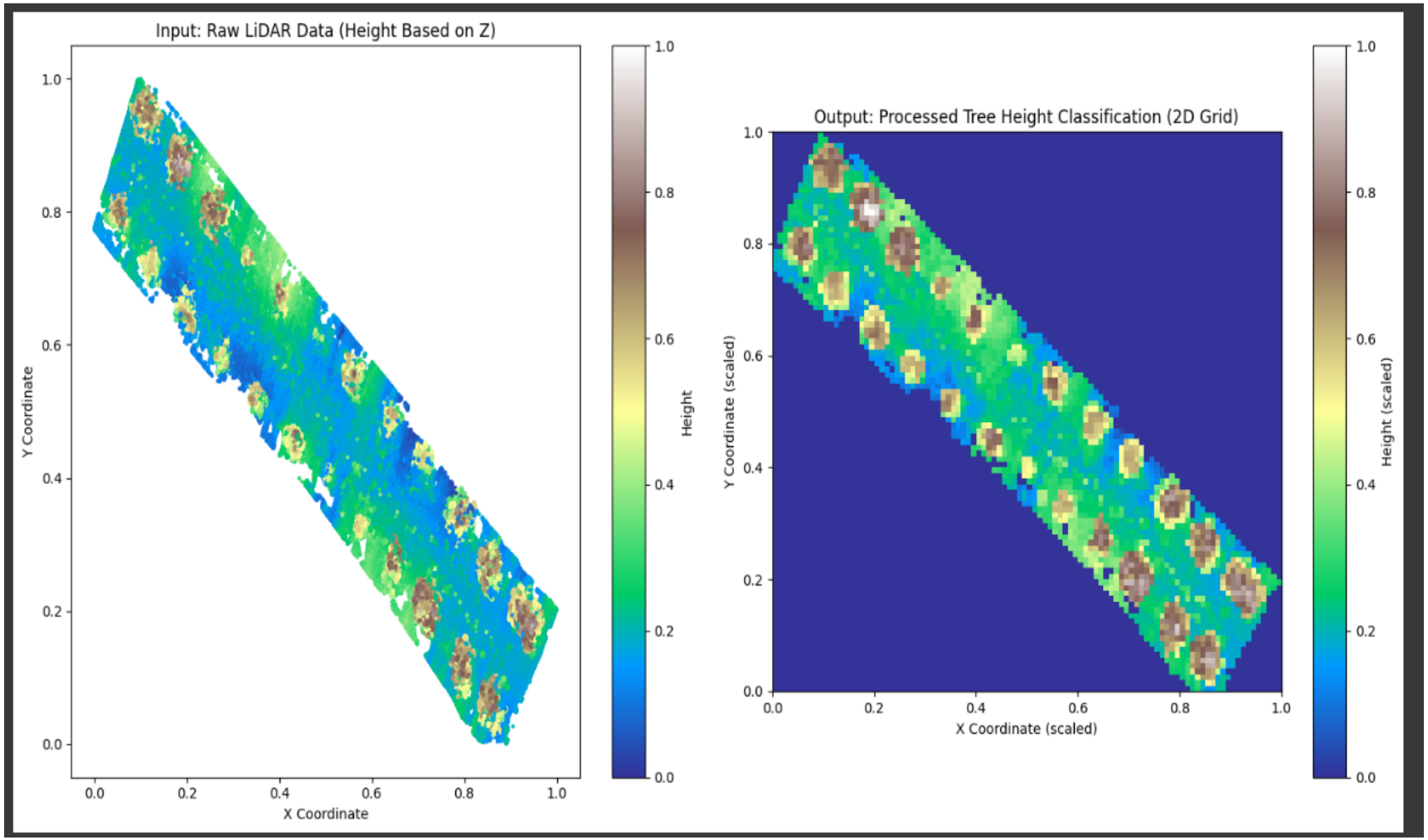
DATA PROCESSING FLOW

- **Point Cloud Reading**: Load point cloud data from `.pcd` file.
- **Point Extraction**: Extract `x`, `y`, `z` coordinates.
- **Normalization**: Use `MinMaxScaler` to normalize coordinates.
- **Grid Binning**: Use `np.digitize` to assign points to grid cells.
- **Height Calculation**: For each grid cell, calculate the maximum height (`z` value).

INPUT AND OUTPUT




Input: Raw LiDAR Data (Height Based on Z)
Y Coordinate
X Coordinate
Height
Output: Processed Tree Height Classification (2D Grid)
Y Coordinate (binned)
X Coordinate (binned)
Height (scaled)


Input: Raw LiDAR Data (Height Based on Z)
Y Coordinate
X Coordinate
Height
Output: Processed Tree Height Classification (2D Grid)
Y Coordinate (scaled)
X Coordinate (scaled)
Height (scaled)

RESULTS AND ANALYSIS

- **Scatter Plot**: Shows raw LiDAR data with color representing tree height.
- **Heatmap**: Displays the 2D grid showing maximum tree heights in each grid cell.
- **Interpretation**:
- This method enables visualization of tree height distribution.
- The grid-based classification allows for efficient analysis over large areas.

CHALLENGES AND LIMITATIONS

- **Resolution**: Grid resolution can affect accuracy.
- **Noise**: LiDAR data may have noise, affecting tree height measurements.
- **Processing Time**: Large datasets may require significant computation time.
- **Height Accuracy**: The method assumes uniform tree distribution, which might not always be the case.

CONCLUSION

- LiDAR provides an efficient, non-destructive method to classify tree heights.
- The grid-based approach is effective for large-scale applications.

- **Future Work**:
  - Increase grid resolution for finer classification.
  - Test the system in diverse real-world environments.
  - Incorporate machine learning for improved accuracy.

THANK YOU