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A Comparative Study of Pointcloud-based Row Detection Algorithms in Different Simulated Agricultural Scenes

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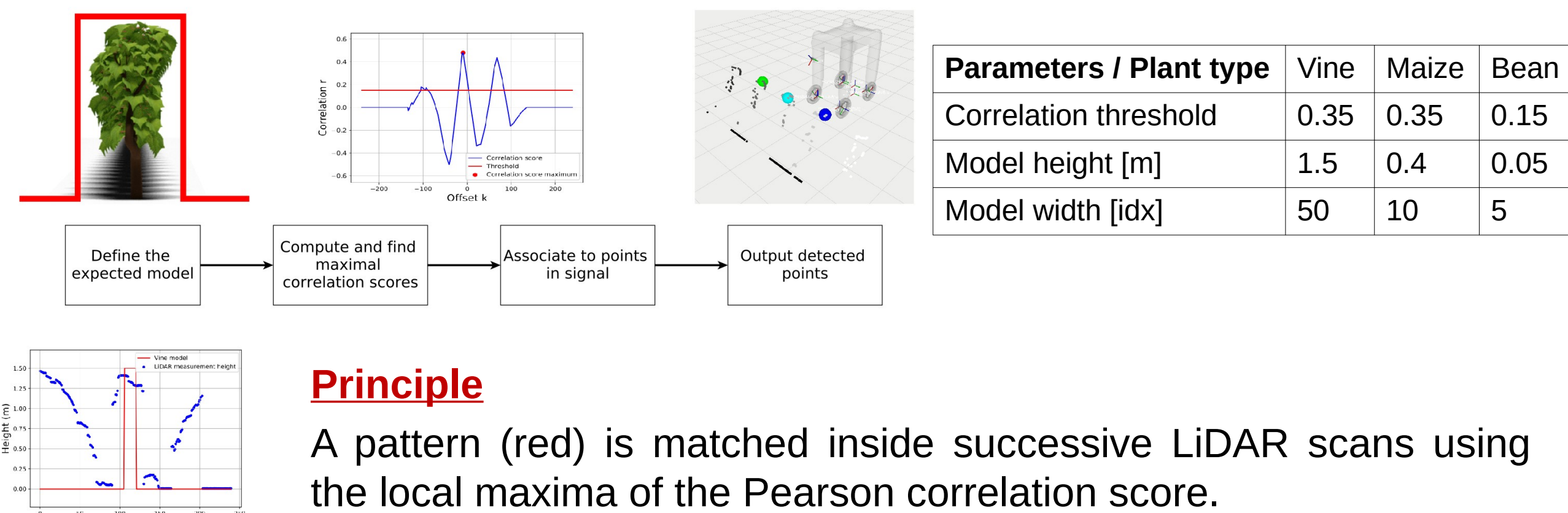
Context

Agricultural robotics is identified as a suitable alternative in the **agroecological transition**, offering a promising solution to increase production rates while alleviating the workload on farmers and reducing the environmental impacts. To achieve these goals, crop monitoring, robot navigation system, spraying and other applications require the **crop rows** to be detected precisely and efficiently. With its high precision and effective range, the **lidar sensor** is a promising choice for **environment recognition**. Even though row detection has been widely investigated for camera applications, lidar-based row detection algorithms need to be compared. Using procedural generation for simulated environments, this study provides a benchmark and methodology to evaluate lidar-based crop row detection algorithms.

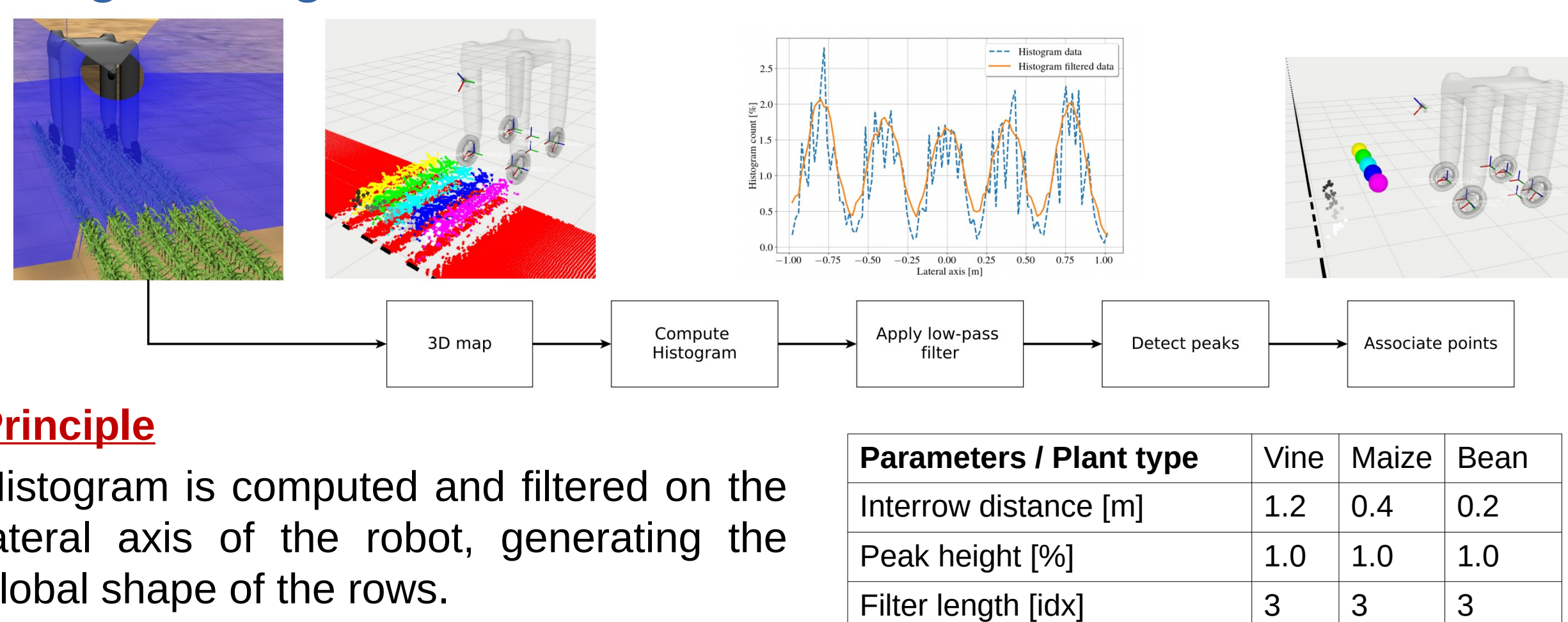
Keywords: Agricultural Robotics, Crop Row Detection, Pointcloud Processing, Automatic Environment Generation.

Lidar-based Row Detection Algorithms

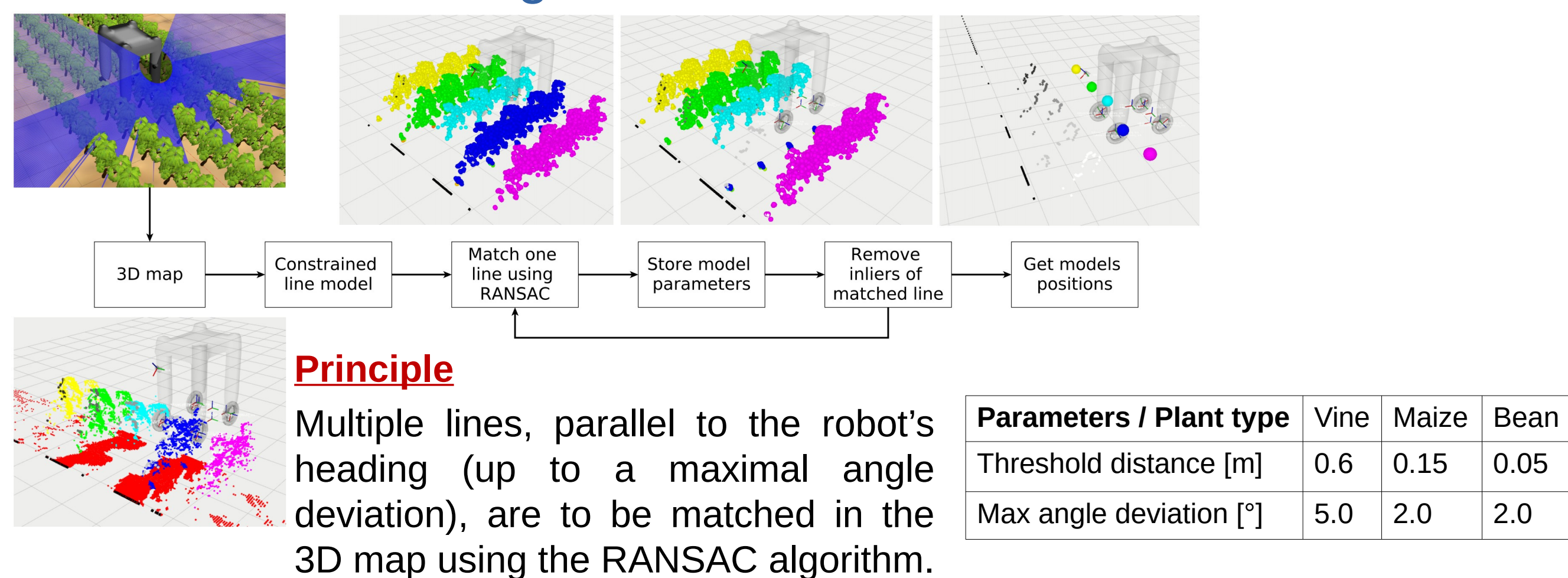
Shape matching algorithm



Histogram algorithm



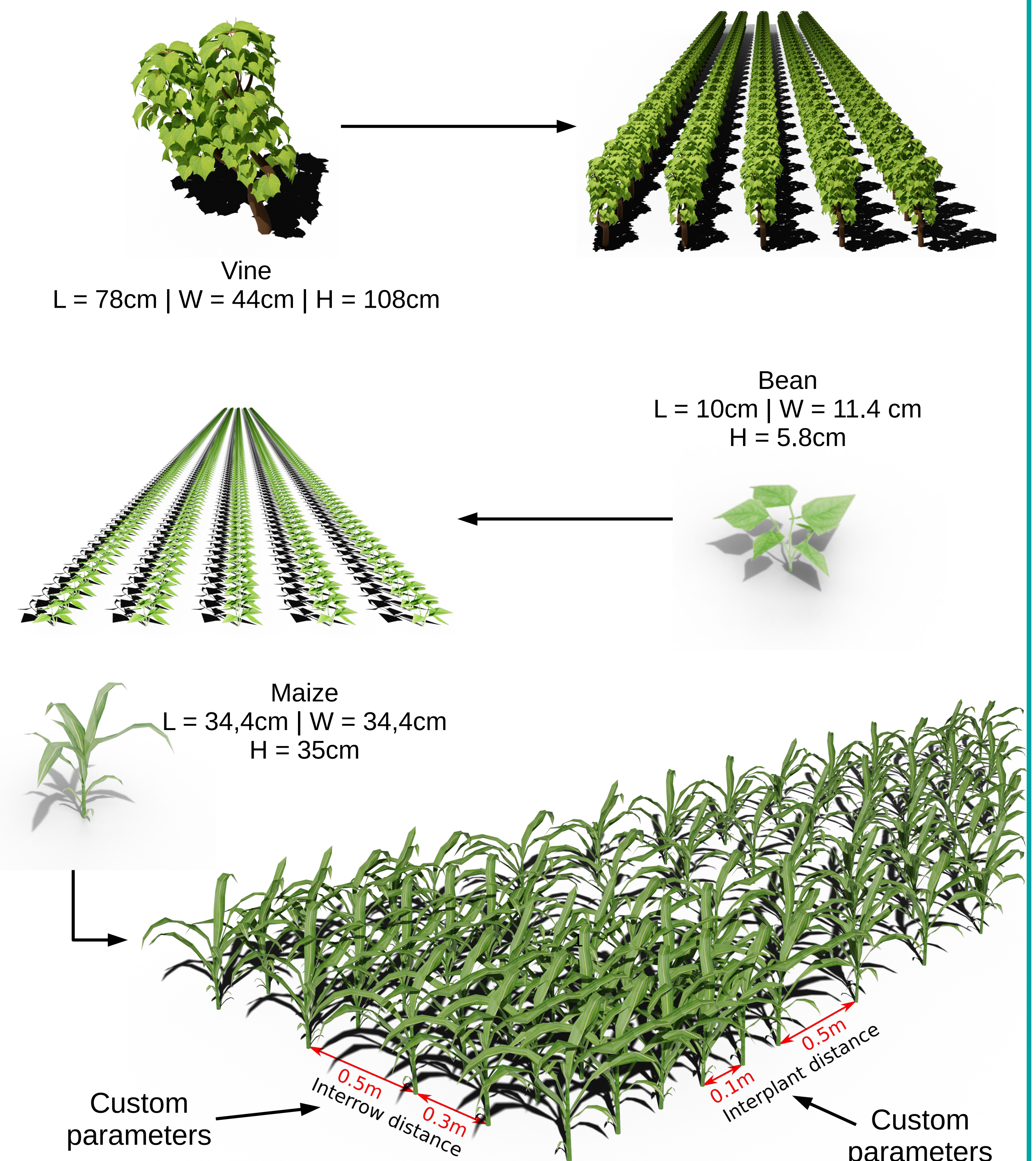
Iterative RANSAC algorithm



Generation of Simulated environments

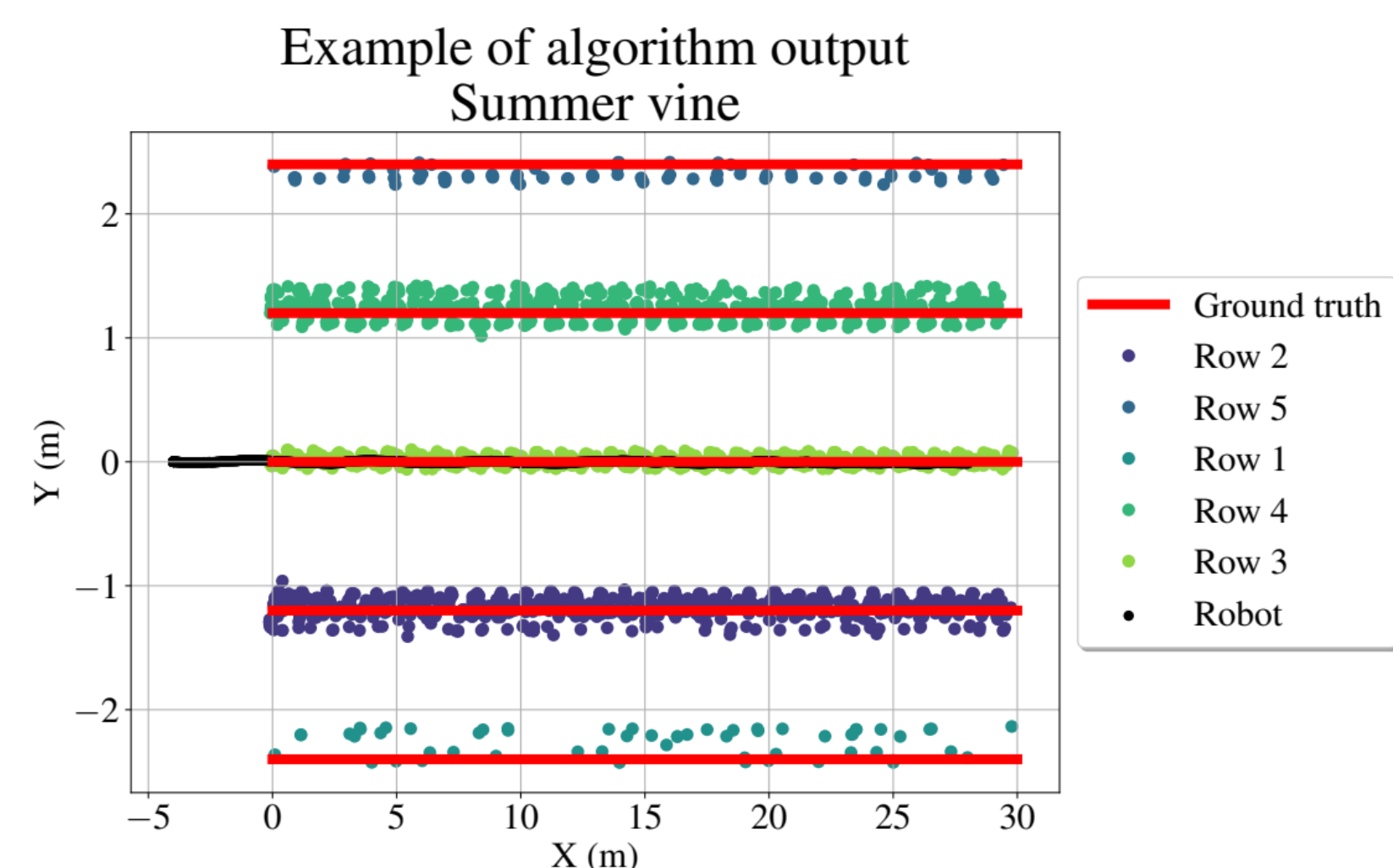
Principle

Individual plants meshes are used to generate rows with specified parameters, enabling fast and massive data acquisition.



Evaluation and Results

Metrics



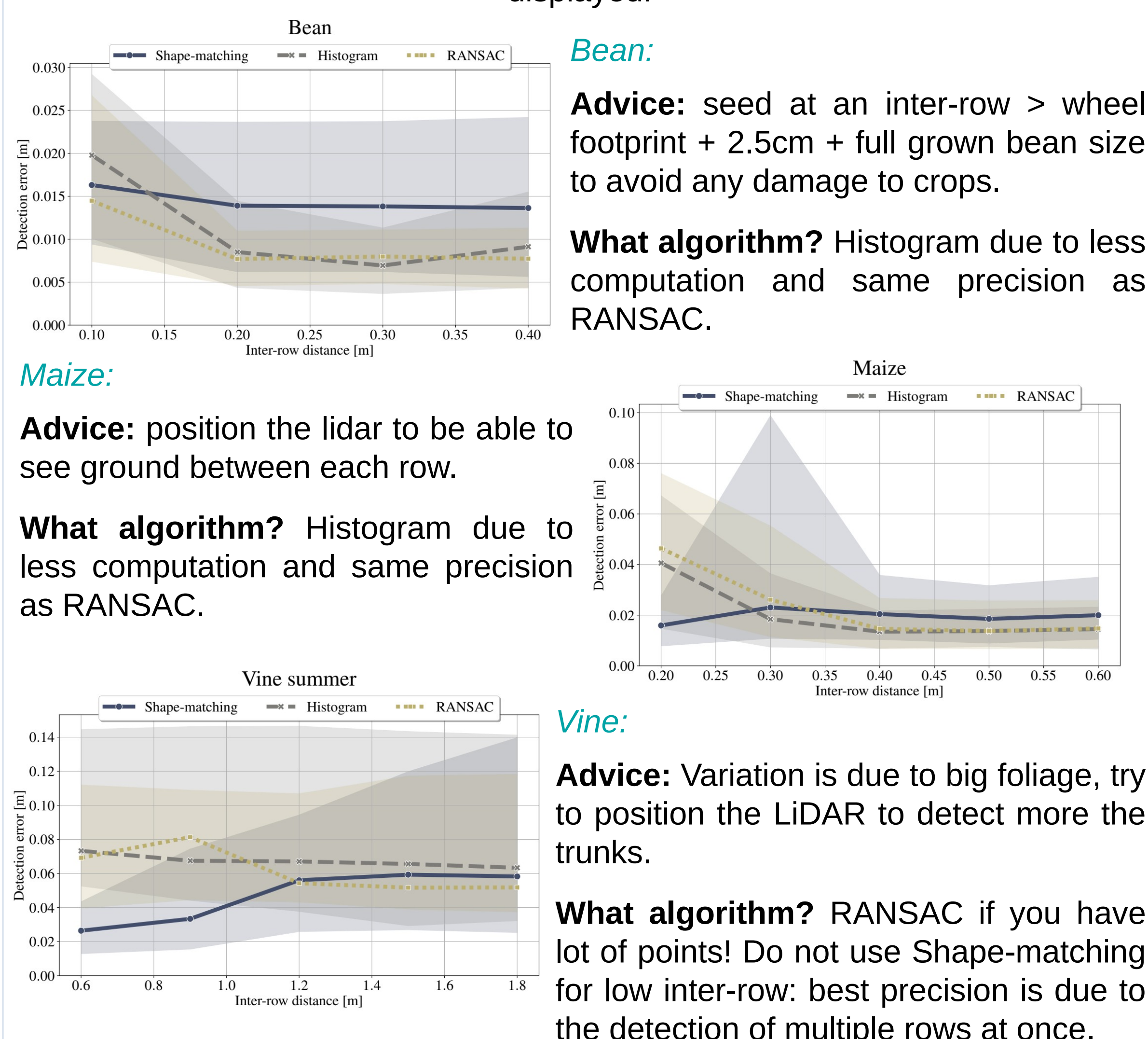
For each row and algorithm :

Precision - distance between algorithm output (points) and associated row.

Detection rate - number of detected rows in the output over the number of rows in the input.

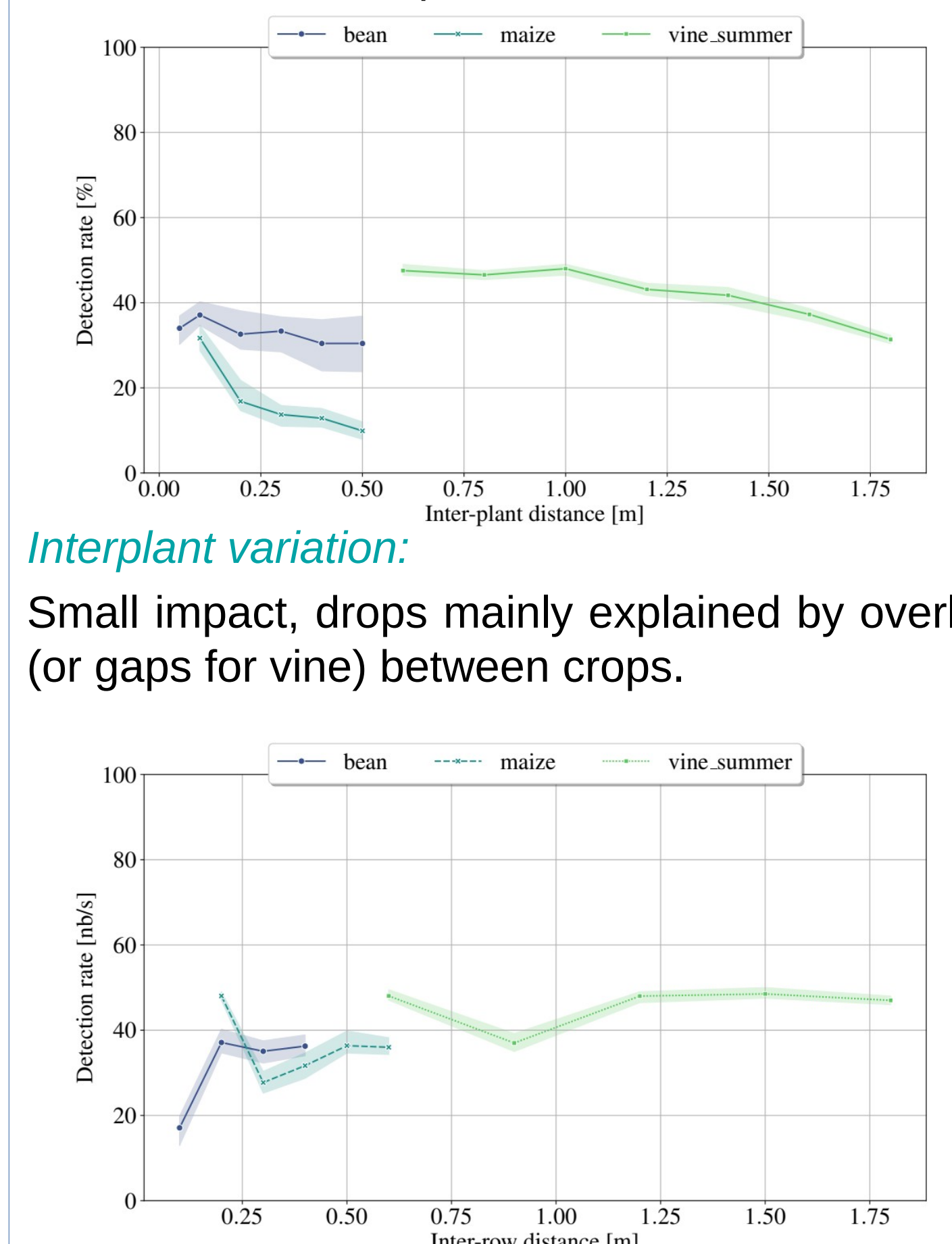
Precision

Results are computed on the central row, only inter-row distance variation is displayed.



Detection rate – Shape-matching algorithm

Results are computed on the central row.



Perspectives and future work

Future works will introduce more parameters in the study, beginning with the impact of seasonality (winter vines), sensor noise and crops alignment using the **CropCraft** tool, leading to a paper describing precisely these results. Simulation results are also to be confirmed with real experiments.